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The design and implementation of a read prediction buffer

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THE DESIGN AND IMPLEMENTATION OF A READ PREDICTION BUFFER

by

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Lieutenant, United States Navy
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ABSTRACT

Cache memories, which are the level of memory between the CPU and the main memory, hold small amounts of data and instructions, and allow the CPU to access the contents in them very quickly. This significantly reduces the read access time for the CPU if the required information is available in the cache. However, caches are small and can only hold the most commonly used data and instructions required by the CPU. When information requested does not appear in the cache, a "cache miss" occurs and the CPU must fetch the required data from the main memory. The Read Prediction Buffer reduces this time-costly read access by attempting to predict the possible miss address, and pre-fetch the read data.

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I.   INTRODUCTION

A. THEORY OF OPERATION

Modern high performance microprocessor systems have increased memory bandwidth, due in part to high speed cache memories that are logically situated between the micro-processor and main memory. The cache itself is much faster than main memory, but is also smaller and can hold only a fraction of the contents of main memory. Cache make-up is of high speed CMOS static memory which has a typical access time of 30 ns or less, whereas main memory is made up of lower speed dynamic memory circuits with typical access times of around 70 ns. [Ref. 1:pp. 2-13]

The contents of the cache is the most recently accessed data and instructions. Whenever the CPU requires data or code, it first checks the cache to see if it is contained there. If not present in the cache, a "cache miss" occurs, and the required information must be obtained from main memory. This causes a substantial time delay until a read access of main memory can be completed and the required data is acquired. Cache miss rates can be quite high, and can significantly reduce system performance. [Ref. 2:pp. 408-428]

The theory of the Read Prediction Buffer is to predict what the next cache miss read address request may be from the pattern shown by the previous reads, to pre-fetch the data and instruction at the predicted address, and to determine if the predicted address matches that of the next read access. In this manner, the information of the future read will be ready and waiting for the CPU when a cache miss occurs.

Read predictions vice write predictions are done for two reasons. First, once a prediction is made a pre-read can be accomplished to pre-fetch the data at the indicated address. However, in the case of a write operation, a pre-write makes no sense since the data to be written is not known and is unpredictable. Second, the CPU stalls whenever a read operation is begun until the operation is completed, for write operations the CPU does not stall so no time is saved in accomplishing any prediction.

B. BASIC DYNAMIC RAM

Dynamic RAMs (DRAMs) store data in one bit cells. Because of this smaller cell size, high density, small package size, and lower costs are possible compared to the faster static RAM (SRAM). These advantages make DRAMs the choice for large main memories.

However, there is a draw-back. DRAM cells are capacitors (unlike SRAM cells which store bits in flip flops) so the stored charge dissipates over time, and the stored data could be lost. Therefore, DRAMs require a refresh of their charge periodically to maintain the stored data. These refreshes are done at fixed intervals, usually about 4 to 8 ms. [Ref. 1: pp. 2-4 - 2-7]

1. Dynamic Memory Operation

Memory operations include the read access, write access, and the refresh operations. A read access is when the processor requests data from a given address and the memory responds with that data. A write access refers to when the processor sends data to the memory to be written at a specific address. The refresh operation can be done using several methods which are determined by the system parameters, but basically refreshes are periodically interspaced between memory accesses to ensure that a refresh is done at least every 8 ms. The refresh operation causes a pause while the refreshing is being accomplished, which means each cell is first read and then written back into with the same data. A counter is utilized to sequence the refresh through all the rows and columns of the memory. The refresh timer is then reset, and return to normal operation is accomplished.

The job of arranging just when these operations should all be done is accomplished by the Dynamic Memory Controller. It utilizes control signals, ready request signals, and timers to determine when a specific operation needs to be done, and in what particular order. [Ref. 1:pp. 2-7 - 2-13]

C. RESEARCH GOALS

The motivation for this thesis is to decrease the apparent read access time to main memory. To accomplish this, a read prediction buffer IC has been designed, developed, and implemented using CMOS VLSI. The IC has an address length of 22-bits for use with 4MEG memory chips. Data length is 9-bits for use with 1-byte memory modules with parity. Simulations of the buffer have been accomplished to ensure it performs reasonable predictions for read accesses, and to confirm layout for fabrication in silicon.

C. REQUIRED CAD TOOLS

The design and layout of the Read Prediction Buffer chip was done on the Naval Postgraduate School's Sun SPARCstations utilizing The University of California at Berkeley's VLSI CAD tool package.

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1. Sun SPARCstation

The Sun Microsystem SPARCstation IPX is a desktop computer that offers high-speed color graphics. Operating at 40-Mhz, the system is equipped with 32 MB of RAM, 207 MB of internal hard drive, and mounts several large file systems from a remote server.

2. Magic

Magic is an interactive editor for creation of Very Large Scale Integration (VLSI) layouts, that runs under various Unix based systems, one of these being the Sun SPARCstation with an integrated color display. Using Magic, the designer can create basic cell layouts, and combine them into larger structures, or even complete chip layouts. The Magic program has a built in design rule checker that constantly checks layouts as they are being created to ensure the layout rules are obeyed for the particular technology being utilized. It knows about connectivity and transistors, and allows the user to extract the created circuits for simulations. Magic only permits Manhattan designs, which are designs whose edges are horizontal or vertical, no diagonal or curved structures are allowed. The further attributes of Magic are numerous and reference to the referred manual is recommended for additional descriptions of its' abilities. [Ref. 3]

a. Peg

The PLA Equation Generator compiles finite state machines to generate a working PLA. It takes a high level description of a finite state machine, and translates it into usable logic equations that are required to implement that design. Peg is a Moore model for finite state machines, which implies that the outputs created are functions of the current state. Inputs can be provided in-order to cause transitions to particular states. The equations generated by Peg are in an "eqn" format which is compatible with the Eqntott program. For this specific finite state machine, the Peg command used was:

peg -s -t **infile** > **outfile**

This allowed for the infile, which in this case was newfsm, to be processed into a truth table for the fsm, and summary information to be created in a peg.summary file. Included in Appendix A. are copies of the finite state machine program newfsm, and its Peged output newfsm.peg. [Ref. 3]

b. Eqntott

Eqntott is a generator that takes the Boolean equations generated by the PLA program and creates a truth table from which a PLA layout may be created. Through various options, the output variables can be made in varied ways. The option chosen for this work was the -l option in which the

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input and output variables are mutually exclusive. Also, a truth table is generated that is compatible with the MPLA program to generate a layout. The command used was:

eqntott -l **infile** > **outfile**

The infile was newfsm.peg and the outfile was newfsm.eq, these outputs may be seen in Appendix A. [Ref. 3]

  c. **Mpla**

    Mpla is a PLA generator that can generate Magic layout compatible PLAs in various styles and technologies. There are several styles of PLAs that are supported by this program, this work was completed in scalable CMOS cis version (SCS3cis). It supports MOSIS 1.5/2.0/3.0 micron SCMOS process, a pseudo-nmos static PLA with p-channel pullups, clocked inputs and clocked outputs if required. The cis stands for buried contacts, with inputs and outputs on the same side of the PLA. Also available was SCS3trans which is the same except the inputs and outputs are on opposite sides of the PLA. A dynamic PLA style is also provided called SCD3cis or SCD3trans.

    The read prediction buffer finite state machine (PLA) utilized clocked current-state inputs and next-state outputs only.

Further options allowed extra ground and power lines to be added to ensure power requirements and electomigration were compensated for. The command used to generate the PLA was:

mpla -I -O -G4 -S4 -s SCS3cis -o **outfile infile**

The infile was newfsm.eq and the outfile was fsm4pla.mag. The completed PLA exhibited a few minor rule violations that required correcting, and the current-state to next-state connections were required, a plot can be seen in Appendix B part F. [Ref. 3]

d. Esim

Esim is the event driven switch level simulator for NMOS or CMOS circuits. It can be entered after the circuit has been extracted in Magic. Esim is used to watch various nodes, to set or reset nodes, and to simulate the operation of the circuit. The watched nodes can then be inspected, and the circuit evaluated. There are numerous commands and options that may be employed in the simulation, and the reader is directed to the reference material for further clarification. [Ref. 3]

e. SPICE3C1

SPICE3C1 is an updated version of SPICE which is a general purpose circuit simulation program. It can perform dc analysis, ac small-signal analysis, and transient analysis. SPICE can also be used to provide extensive plotting of circuit parameters and circuit behavior using its plot command. SPICE is a tremendously powerful tool in observing just how circuits are acting, but it has a limitation in that large circuits take an extremely long time to process. It was for this reason that it was used mainly for power estimations. Esim was utilized for logic simulations. [Ref. 4]

E. THESIS STRUCTURE

The algorithm description and fundamental block designs are discussed in chapter II. The implementation and basic cell descriptions along with electronic parameters are shown in chapter III. Simulations of the finite state machine and the final complete circuit will be presented in chapter IV. Chapter V outlines the thesis conclusions and further recommendations.

II.   READ PREDICTION ALGORITHM AND BUFFER DESIGN

A. THE READ PREDICTION ALGORITHM

The RPB algorithm is an original idea of Professor Douglas J. Fouts and has not yet been fully characterized and evaluated. However, it is under study in a current parallel thesis to determine its computer enhancement possibilities. [Ref. 5]

The Read Prediction Buffer (RPB) uses two addresses, a previous address and a current address, to determine an offset, which is the difference between the two addresses. Two read requests are required to obtain these addresses. A basic flow chart is shown in Figure 1.

The first read request gives the current address, the second read request causes a transfer of the current address into the previous address, and the second read request address becomes the new current address. The previous address is now subtracted from the current address to determine an offset. The offset will be either a positive or a negative value depending on whether the current address was greater than or less than the previous address. This offset is then added to the current address to determine a new predicted address. It is this address that is then used to pre-fetch the predicted data (9 bits).

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When the next read request occurs (the third read) the requested address is first compared to the predicted address. If there is a match, the predicted data will then be retrieved. If they do not match, a normal read access of main memory will be conducted. Either way, the new read address will become the current address, the old current address will be transferred to the previous address, and a new predicted address will be calculated.

1st Read Access

1   Load Read Address to Current Address

2nd Read Access

Transfer Current Address to Previous Address

Load Read Address to Current Address

2   Subtract Previous Address from Current Address, Obtain Offset

Add Offset to Current Address get Predicted Address

Use Predicted Address to fetch Predicted Data

3rd Read Access

3   Compare 3rd Read Address to the Predicted Address

No Match

Match

4   Send Predicted Data to CPU

Figure 1.   Basic RPB Algorithm Flow Chart

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B. RPB DESIGN

In order to implement the RPB algorithm, several functional blocks will be utilized, as shown in Figure 2. The Current Address Register is a 22-bit register which receives the Read Address on the Address Bus from the CPU. Its output goes to the Previous Address Register, the Subtractor, and the Adder.

The Previous Address Register is a 22-bit register and a two's compliment convertor, which is used to provide the subtraction operation of the Subtractor that receives it's output.

The Subtractor is really a 23-bit (22-bits plus a sign bit) adder that utilizes the two's compliment output of the Previous Address Register, and adds it to the output of the Current Address Register. Functionally, it appears as if the Previous Address Register contents are subtracted from the Current Address Register contents. This creates an offset which is then sent to another 23-bit Adder to be combined with the output of the Current Address Register to form a Predicted Address.

The Adder sends the Predicted Address output to the Comparator, the Address Multiplexer, and a most significant bit (sign bit NEG) to the Finite State Machine to indicate a negative Predicted Address.

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The Comparator XOR compares the Predicted Address output of the Adder with the address on the Address Bus from the CPU, which will be either a read or a write address from the CPU. The output of the Comparator XOR will be either a MT for an address match or a NMT for an address no-match condition, which goes to the Finite State Machine.

The Address Multiplexer is a 22-bit 2-to-1 multiplexer that receives the Predicted Address from the Comparator XOR and the Read or Write Address from the CPU. Selection of one of these addresses is then sent to the Main Memory (off-chip) under control from the Finite State Machine.

The Data Multiplexer is a 9-bit 2-to-1 multiplexer that will receive the Read Data output from Main Memory and the Data Line from the CPU, and under control from the Finite State Machine will output to the Predicted Data Register.

The Predicted Data Register is a 9-bit register that receives the selected predicted data and outputs it to the Output Multiplexer.

The Output Multiplexer is another 9-bit 2-to-1 multiplexer which has inputs of the Read Data from Main Memory and the Predicted Data from the Predicted Data Register. Its' output is controlled by the Finite State Machine. The selected data is sent to the computer systems' cache memory for use by the CPU.
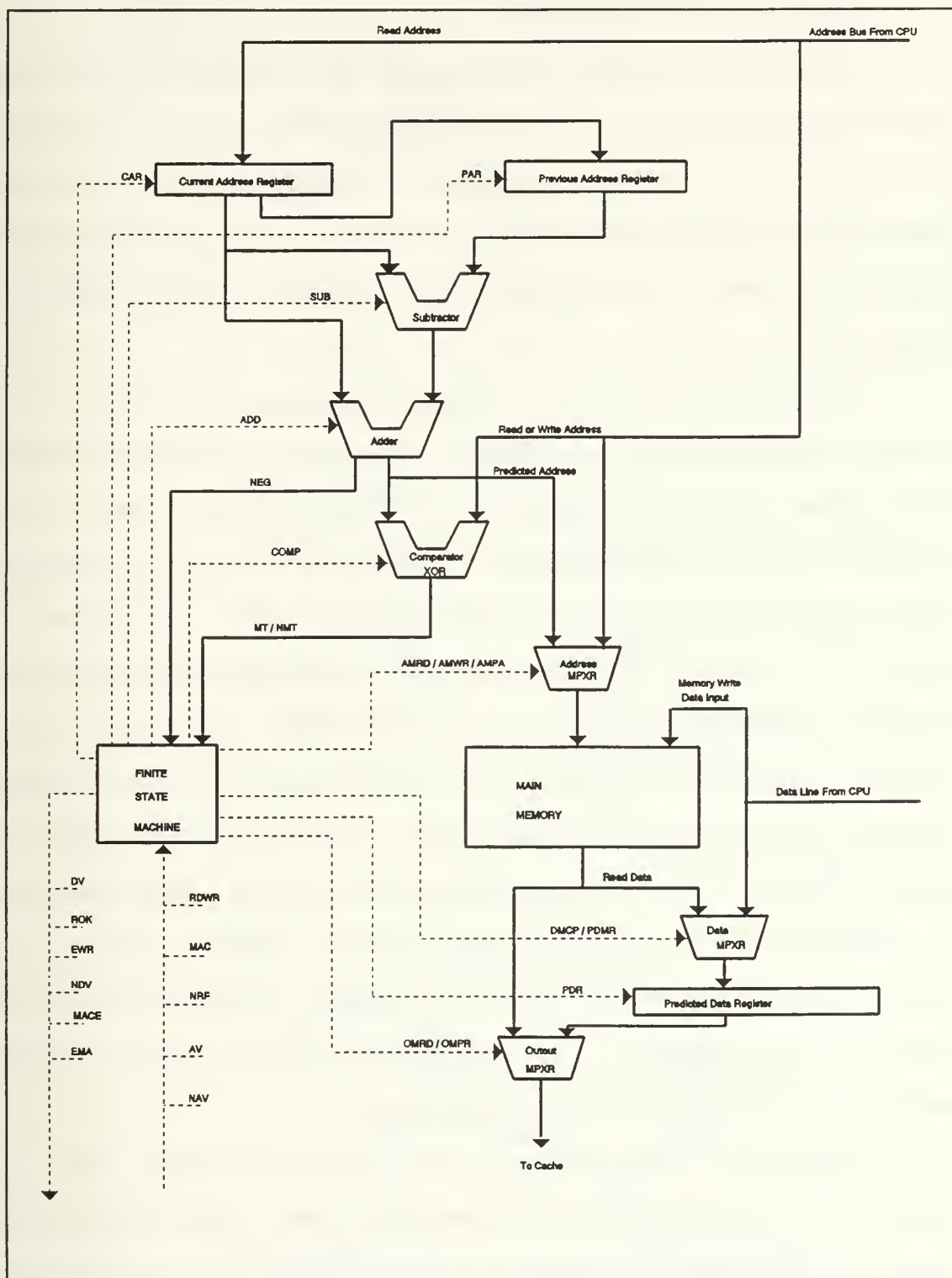
Figure 2.   Read Prediction Buffer Block Diagram

1. Finite State Machine

The Finite State Machine is the brains of the Read Prediction Buffer. It coordinates the control signals necessary for correct sequential operation of the RPB. Basically a Programmable Logic Array, the outputs and required inputs are best described by the use of the flow chart in Figure 3.

Starting at State 0 (state numbers are written in binary format on the flow chart), signals Not Data Valid (NDV) and Refresh OK (ROK) are issued. NDV and ROK are sent to the Dynamic Random Access Memory (DRAM) controller to indicate that data is not valid and that REFRESH can be allowed to occur. If a Write operation occurs, signals Not Read/Write (!RDWR), Address Valid (AV), and No REFRESH (NRF) are issued and the transition to state 1 is taken. Here, output control signals Enable Memory Access (EMA), Select Address MPXR for Write Address (AMWR), and Enable Write pulse (EWR) are sent out. EMA starts the memory access timer, AMWR allows for the selection of the write address from the CPU address bus to be gated to main memory, and EWR sends a write pulse to main memory to initiate a write operation.

When the Memory Access Complete input signal (MAC) is received, (a function of the memory access timer timing out) state 2 is entered. At state 2, Data Valid (DV) is issued to the DRAM controller.

Figure 3.   Finite State Machine Flow Chart

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When the controller sees DV, it drops its Address Valid (NAV) and the state machine returns to state 0 to look for a read or write operation. This sequence is referred to as the write sequence, it will be repeated each time a write operation is encountered.

When a read operation is encountered, the signals Read/Write (RDWR), AV, NR are received, and state 3 is entered. In state 3, the memory access timer is started (EMA), the Address MPXR allows the read address from the CPU to be gated to main memory (AMRD), and the Current Address Register to be loaded (CAR) for the first read. Again, when the memory access timer times out, MAC is received and the transition to state 4 is taken.

State 4 sends out a signal to Enable the Output MPXR for a Read Address (OMRD) to be gated to the systems' RAM, and DV is issued to the DRAM controller. The controller responds with NAV, ending the read operation and the state machine goes to state 5. Here, operation is virtually the same as described earlier, a write operation will cause a transition to states 6 and 7, with the same signals produced as in the write operation previously discussed. The return from this write will be to state 5 vice state 0, as before.

A read operation (the second read) will proceed to state 8, where in addition to the same signals generated in state 3, a signal to Load the Previous Address Register (PAR)

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will be issued before the CAR in-order to transfer the contents of the current address register to the previous address register. This is done before the current address register is loaded with the address of the second read. When the MAC signal is received, state 9 is entered so that the conclusion of the read operation can be done with the signals OMRD and DV. Also, Subtract (SUB) and ADD are issued which cause the previous address register to be subtracted from the current address register to obtain the offset, which is then added to the current address register to get a predicted address.

State 10 is activated when the controller issues the NAV signal, and its here that a memory access operation to pre-fetch the predicted data is done. In state 10, signals to start the memory access (EMA), Enable Address MPXR for the Predicted Address (AMPA) (to select the predicted address just calculated sent to the main memory), and Not Data Valid (NDV) (which is sent to the controller to let it know that the state machine is ready for another read or write request) are sent out. When MAC is received from the memory access timer, state 11 enables the Data MPXR for Read Data (PDMR) and the signal Load Predicted Data Register (PDR), which selects the new predicted data from the main memory to be gated to the Predicted Data Register.

The next state is state 12 which again monitors for the write or read operations. The write operation will send the flow to state 13, but now with a slightly different sequence than the previous two times. If a write operation should come along after the second and subsequent reads, a write coherency problem could be created.

A write coherency problem refers to the condition that if a write operation should occur at the same address that happens to also be the predicted address, the data present in the predicted data register would then be invalid because the new write operation would be changing it. Thus, in-order to protect against this condition, the write address will be compared with the predicted address to determine if they are the same. If they are equal then the new write data will replace the predicted data.

In state 13, a compare (COM) is done with the write address and the predicted address, the Address MPXR is selected for a Write Address (AMWR), and EMA timer is started. State 14 will be entered upon a No Match (NMT) condition, and will issue EWR to the main memory.

State 15 is entered if a Match (MT) condition is encountered. Besides issuing EWR, the signals for the Data MPXR for CPU Data (DMCP) and Loading the Predicted Data Register are sent, which allows the new write data to replace the predicted data in the Predicted Data Register.

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MAC will transfer either state 14 or 15 to state 16 so the Data Valid (DV) can be sent to the controller. The controller then responds with a NAV which allows state 17 to send out NDV, and return the state machine to state 12.

If a read operation should occur, state 18 will be entered where AMRD and COM are sent out, so that the read address (the third and subsequent reads) can be compared to the predicted address. Signals to load the Current and Previous Address Registers CAR and PAR are also sent out at this time to ensure the new and the old read addresses are placed in their respective registers.

If there is no match (NMT), state 19 sends out EMA (for a new read memory access) and enables the Output MPXR for Read Data (OMRD). This causes the main memory to do a normal read access and the read data will be transferred to the systems' cache.

However, if a match occurs, then state 20 sends out DV, enables the Output MPXR for Predicted Data (OMPR), and a signal is sent to the controller to cause the Memory Access Timer to Complete early (MACE).

Both states 19 and 20 pass control to state 21 when MAC is sent out by the DRAM controller. State 21 sets up the entire prediction calculation sequence again by sending out SUB, ADD, and DV, causing a new predicted address to be calculated, and with NAV in, it sends the flow back to state 10. The state machine cycles again to fetch the predicted data and monitor for the next read or write operations.

One other signal is used (NEG) for detecting the possibility that a negative value for the predicted address could occur from the addition of the offset and the current address. Should this NEG signal be generated, the state machine resets back to state 0 since the calculation of the predicted address is negative and negative addresses would be invalid.

III.   IMPLEMENTATION

The basic logic design of each of the cells used in the make-up of the Read Prediction Buffer will be shown, to give an understanding of the design characteristics of the cells. The basic cell layouts are include in Appendix B so that the reader can see how the basic cell descriptions given in here look in a Magic layout format. The cell reproductions were created using the cif2ps function. A legend for the cif2ps plot representations is included to aid in readability. The reader is directed to the reference material for further information on the cif2ps plotting function. [Ref. 3]

A. REGISTER CELL

The register cell is a Master Slave Flip Flop (MSFF) which is comprised of two Latches. The latches are built from three inverters, two of which are clocked inverters, as seen in Figure 4 and Figure 5. [Ref. 6:pp. 11]
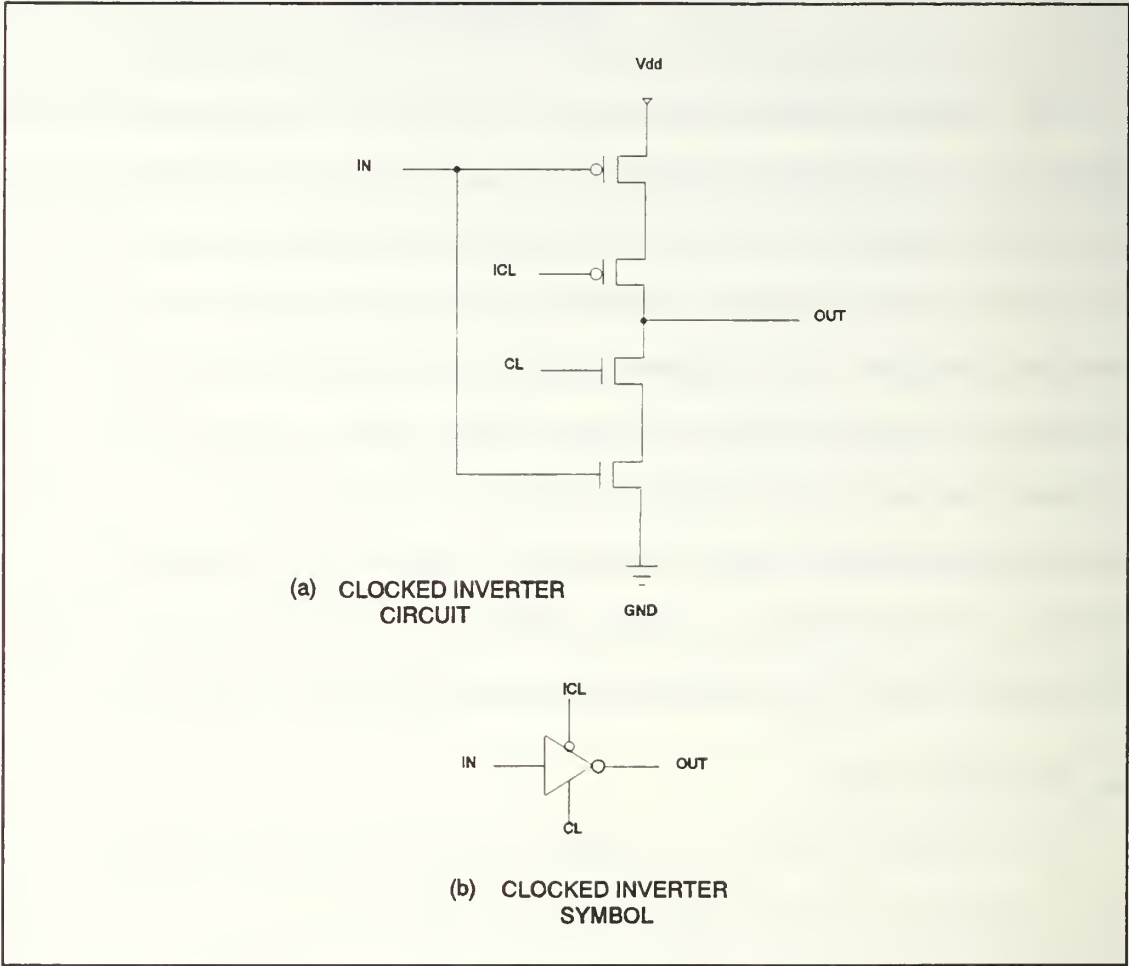
Figure 4.   Clocked Inverter

The clocked inverter (Figure 4), which is also called a tri-state inverter, uses the clock signals CL and !CL along with the input to drive the output. When CL = "0", (!CL = "1") the output is not driven by the input. When CL = "1", (!CL = "0") the output is then driven by the inverse of the input. [Ref. 7:pp. 55]

24
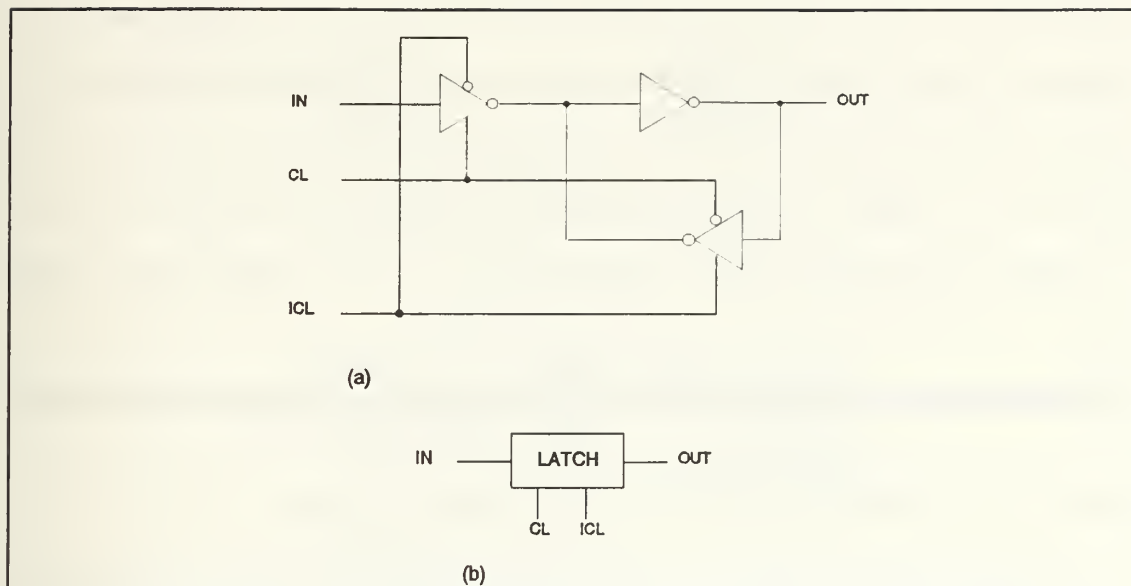
Figure 5.   Latch Make-up (a), Latch Symbol (b)

The latch internals are shown in Figure 5(a), this illustrates that the circuit works functionally like a D latch, that is with a logic "1" input, and clock a logic "1" (CL=1, !CL=0), the output will also be a logic "1". When clock is a logic "0" (CL=0, !CL=1), then the output will remain at whatever level it was at, a holding condition. Part b of Figure 5 shows the logic symbol for the latch. [Ref. 8:pp. 358-360]

The MSFF is made-up of two of these latches and an inverter as shown in Figure 6.   Internally, the first latch acts as a Master Latch, and the second latch acts as the Slave Latch. The register cell will be loaded whenever clock is a logic "1" (CL=1, !CL=0), and held to whatever the input value is in the master latch.

25
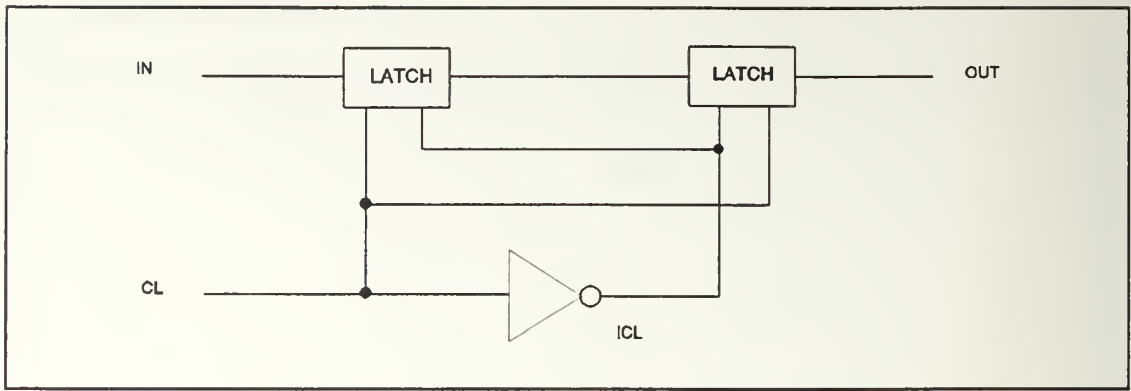
Figure 6.   Basic Register Cell

When the transition of the clock from a logic "1" to a logic "0" (CL=0,!CL=1) occurs, the master latch outputs to the slave latch, and the register will provide an output equal to that which was held while clock was a logic "1". [Ref. 5:pp. 11] [Ref. 8:pp. 363-364]

1.   Two's Compliment Register

This cell combines three components, the basic register cell, an inverter, and the basic adder cell, to produce a two's compliment representation of the address input. The two's compliment of a binary number is created by inverting each of the bits and adding one. Hence, the inverter completes the inversion, and the adder allows one to be added to the least significant bit of the inverted number. See Figures 6 and 7 for examples of the register and adder cells. [Ref. 8: pp. 13]

B. ADDER CELL

The basic adder cell is a combinational adder that follows the truth table as shown in Table I. Here, A and B are inputs, C is the carry-in from the previous stage, SUM is the sum output, and CARRY will be the carry-out to the next stage.

Table I.   ADDER TRUTH TABLE

C	A	B	A*B	A+B	A⊕B	SUM	CARRY
0	0	0	0	0	0	0	0
0	0	1	0	1	1	1	0
0	1	0	0	1	1	1	0
0	1	1	1	1	0	0	1
1	0	0	0	0	0	1	0
1	0	1	0	1	1	0	1
1	1	0	0	1	1	0	1
1	1	1	1	1	0	1	1

A * B is the generate signal that occurs when a carry is generated internally from the cell. A + B is the propagate signal that will pass a one to the CARRY output when C is a one. The boolean equations for this truth table yield:

$$SUM = ABC + A!B!C + !A!BC + !AB!C$$

$$CARRY = AB + AC + BC = AB + C(A + B)$$

Notice that the sum equation breaks down further to A Exclusive ORed with B Exclusive Ored with C, which can be verified from the truth table. These equations translate into the following gate cell as shown in Figure 7. [Ref. 7:pp. 310-312]

27
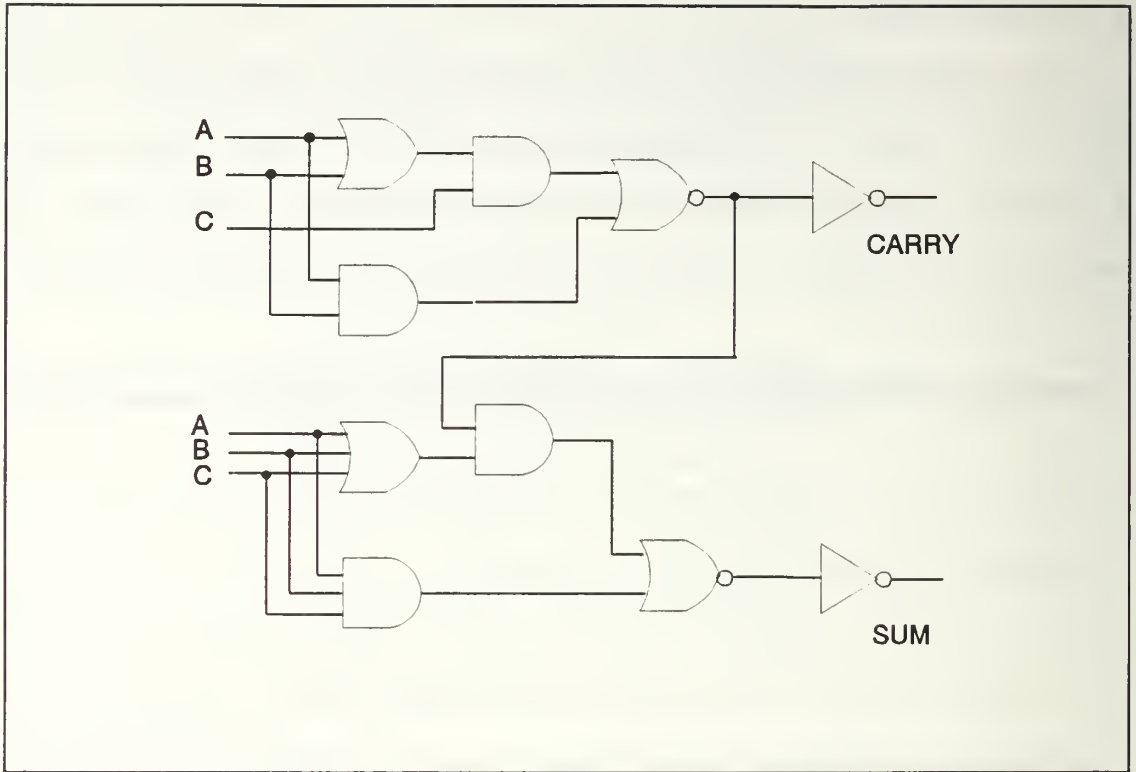
Figure 7.   Basic Adder Cell

C. COMPARATOR CELL

To compare between two addresses a bit by bit comparison is necessary. Only a Match or No-Match condition is required, therefore, XOR gates can be used to determine if any one of the bits is different. Hence, the basic comparator is made-up from XOR gates. The simple make-up of the XOR is shown in Figure 8. [Ref. 7:pp. 333-334]

28
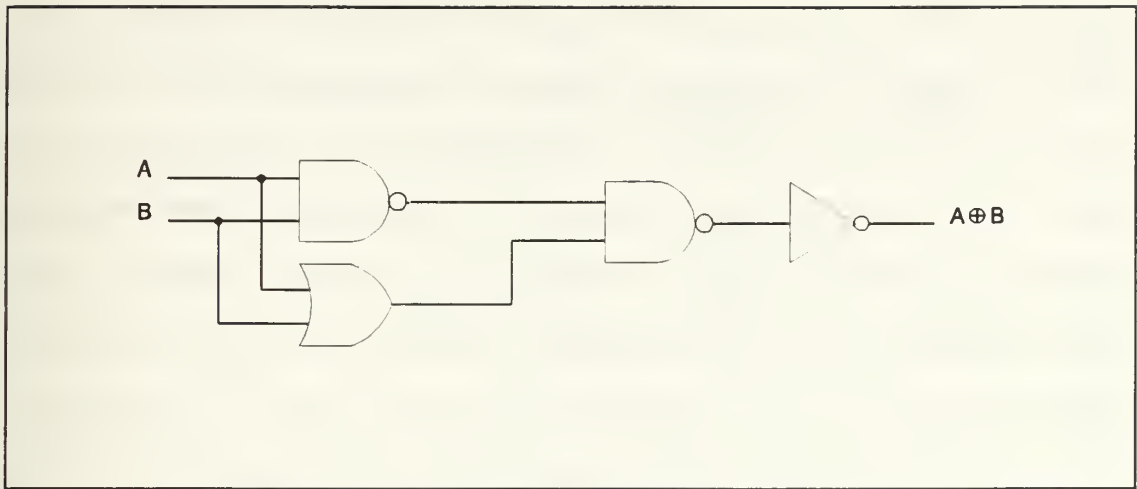
Figure 8.   Basic Comparator Cell

D. MULTIPLEXER CELL

The multiplexers (MPXR) used in the Read Prediction Buffer are all 2-to-1 MPXRs that act like a switch, they select one line or the other depending on whether the select line is a 1 or a 0. However, these particular switches are unidirectional devices that only allow data or information to flow from the input to the output. The basic MPXR cell is shown in Figure 9. The two input lines are X and Y respectively. X is selected when "0" is on the SEL line and Y is selected when SEL is a "1". The enable line ENBL must be a logic "1" for either of the lines to be selected. This gives the controller, or in our case the finite state machine, the ability to turn the MPXR on or off as desired. [Ref. 8:pp. 278-280]

29
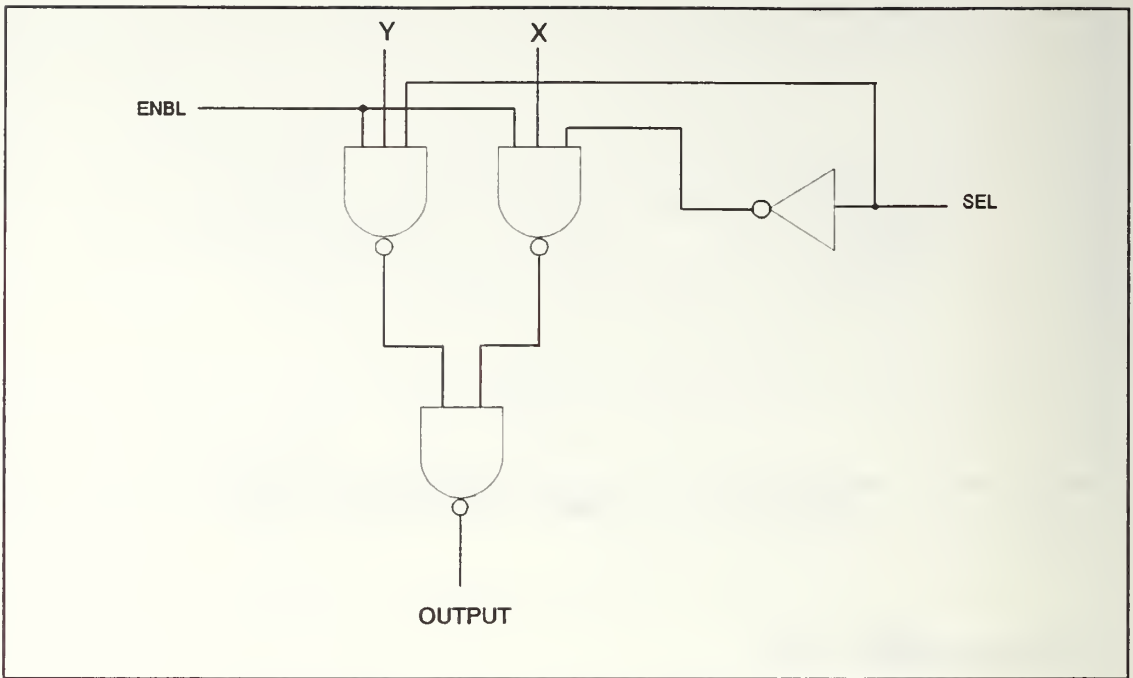
Figure 9.   Basic Multiplexer Cell

E. FINITE STATE MACHINE

Creation of the finite state machine was not as simple and straight forward as the other cells. First, the flow chart of Figure 3 was developed. Then, a PEG program was written for the PLA generator CAD tool PEG. (See Appendix A.) The PEG program defines the inputs, outputs, and state definitions. The program is run through the PEG generator to create the logic equations in a format that can be accepted by another CAD program called EQNTOTT.

Eqntott generates a truth table representation of the PEG program from a set of boolean equations which define the PLA outputs in terms of the inputs. (See Appendix A.)

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This output is then sent to the MPLA program which is a PLA generator that generates the PLA in several different styles and technologies. The technology selected for this work was scalable CMOS cis version. (See Mpla section I.D.2.c.) From this, a MAGIC layout was produced that could be slightly modified to obtain the final working layout that can be viewed in Appendix B. Some work was required on the output of MPLA, such as cleaning up various Design Rule Checker (DRC) faults that were created by the MPLA program, and connection of the next-state outputs to current-state inputs. Also, because the next-state outputs and current-state inputs have been clocked in the PLA design by choice, the current-state inputs where clocked by signals clka and clkabar, while the next-state outputs are clocked by signals clkb and clkbbar. To handle the clkbar functions, two inverters were subsequently added, so that only clka and clkb need be provided. [Ref. 9:pp. 1-10]

F. POWER ESTIMATES

Electromigration refers to the transport of metal ions through a conductor that results from excessive current flow through the conductor. To prevent electromigration, it is required that the conductors be of sufficient size to handle the power and ground currents of the circuit.If the conductor is not wide enough to handle the load on it, it may ultimately become an open circuit, causing the failure of the circuitry.

This is due to the fact that in a conductor of insufficient size, a high current density causes a build up of heat, and if too great, can cause the conductor to blow like a fuse. In order to determine the proper size of conductors, particularly those for Vdd and GND (Vss), it was necessary to estimate the current density in the Vdd and GND supply rails.   [Ref. 7: pp. 144]

A rule of thumb for current density was used of 1.0 mA per sq.um of metal for both the Vdd, and GND. The design of the Read Prediction Buffer uses both Metal1 and Metal2 for Vdd and GND routing. The minimal cross-sectional area for metal is 3 microns wide by 0.5 micron thick. Therefore, a 3 micron strip of metal would have a maximum current rating of 1.5mA. [Ref. 10:pp. 206-209]

Another consideration is the voltage drop of the conductors. This is due to the resistance of a narrow section of conductor which causes an IR drop on the line. Hence, conductors must be of sufficient size in order not to accumulate a large voltage drop and limit the voltage being delivered to the circuit for proper operation. To determine proper conductor widths the formula used to calculate the conductor resistance is

$$Rc = Rs(L/W) \quad (ohms).$$

where

$$Rs = \text{sheet resistance}$$

$$L \;\; = \text{conductor length}$$

$$W \;\; = \text{conductor width}$$

Then using the conductor resistance the voltage drop on each of the conductors can be calculated using Ohms Law $(V = IR)$.

SPICE3C1 a general-purpose circuit simulation program that provides among other things dc and ac analyses, was utilized on all the basic circuit cells to determine peak current consumption of each circuit. Voltage drops were then calculated using peak current estimates and a nominal value of .05 ohms for the sheet resistance of the conductors. Armed with these voltage drop estimates the size of the conductors were varied in order to ensure proper power and ground conductor sizing (see Table II and Table III). [Ref. 4]

From the data presented in Table II, the adder cell presented the most difficulty due to the fact that the current could be as high as 11.58 mA whenever three "ones" were being added in one cell. It was decided that this occurrence in 22-bits would only occur approximately 20% of the time, and was calculated on that basis. To error on the side of safety, one other technique was applied in that extra supply points (from both left and right sides) where added to distribute power and ground. [Ref. 7:pp. 144-149]

Table II. BASIC CELL PEAK CURRENTS

BASIC CELL	22/23-BIT CELL	9-BIT CELL
MPXR		
.32 mA	7.04 mA	2.88 mA
REG		
.464 mA	10.672 mA	4.178 mA
COMP		
.1875 mA	4.125 mA	N/A
ADDER		
.437 mA	68.051 mA	N/A
11.58 mA (3-"1'S")		

Table III shows the basic cell resistances and their voltage drops as calculated utilizing the data in table II.

Table III.   CELL RESISTANCE AND VOLTAGE DROPS

Cell Name Conductor	Left Side	Right Side
Cur. Adrs. Reg.		
Vdd	1.92 Ohms	2.45 Ohms
	.0205 Volts	.0261 Volts
GND	1.74 Ohms	2.34 Ohms
	.0185 Volts	.0250 Volts
Prev. Adrs. Reg.		
Vdd1	.620 Ohms	1.01 Ohms
	.0068 Volts	.0107 Volts
Vdd2	.159 Ohms	.272 Ohms
	.0017 Volts	.0029 Volts
GND1	.128 Ohms	.396 Ohms
	.0014 Volts	.0042 Volts
GND2	.080 Ohms	.202 Ohms
	.0009 Volts	.0022 Volts
Adder /Subtractor		
Vdd	.176 Ohms	.328 Ohms
	.0120 Volts	.0223 Volts
GND	.087 Ohms	.187 Ohms
	.0059 Volts	.0128 Volts
Comparator		
Vdd	5.68 Ohms	6.97 Ohms
	.0234 Volts	.0287 Volts
GND	5.86 Ohms	7.44 Ohms
	.0240 Volts	.0307 Volts
Adrs. MPXR		
Vdd	4.27 Ohms	2.21 Ohms
	.0300 Volts	.0158 Volts
GND	4.03 Ohms	1.29 Ohms
	.0284 Volts	.0091 Volts
Data MPXR		
Vdd	3.07 Ohms	2.09 Ohms
	.0088 Volts	.0061 Volts
GND	2.24 Ohms	1.53 Ohms
	.0065 Volts	.0044 Volts
Pred. Data Reg.		
Vdd	.701 Ohms	.422 Ohms
	.0029 Volts	.0018 Volts
GND	.494 Ohms	.210 Ohms
	.0021 Volts	.0009 Volts
Output MPXR		
Vdd	1.40 Ohms	2.11 Ohms
	.0040 Volts	.0061 Volts
GND	.639 Ohms	1.54 Ohms
	.0018 Volts	.0044 Volts

IV.   SIMULATIONS

All logic, including the finite state machine, was simulated using the event driven logic-level simulator Esim. The registers, adders, comparator, and multiplexers were all simulated to perform their respective functions. Rather than present redundant performance data on each, only the finite state machine and the entire chip simulation data will be presented.

A. FINITE STATE MACHINE TESTING

The clka signal for the current-state inputs was provided by a vector of inputs to be a logic "1" for two clock periods and then a logic "0" for four clock periods. This is followed by the clkb signal which was declared a logic "0" for three clock periods, then a logic "1" for two clock periods, then a logic "0" for one clock period. Appearing as this:

<div align="center">

clka 110000

clkb 000110

</div>

These six clock pulses set up the timing for the PLA so that each clock would be "on" for two clock periods while the other clock was "off", followed by one clock period where neither was active. The simulator could now be run through a group of cycles that would repeat the clock pattern so that the output

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states could be monitored to ensure watched nodes changed as designed. Appendix C part A contains the collected data of simulation run on the finite state machine. It is recommended that the data be read with the finite state machine flow chart in Figure 3 so that the state flow can be followed.

B. RPB CIRCUIT TESTING

The testing of the entire read prediction buffer required that the Computer System, CPU Address Bus, Main Memory, and the Data Line from the CPU all be simulated as inputs in order to ensure the internal performance of the RPB. To accomplish this, all data lines have been labeled so that each line could be set or observed to ensure proper operation of the circuit. Shown in Figure 10 is the convention used for labeling. The circuit simulation run data is presented in Appendix C part B for inspection. The simulation run is very similar to that of the finite state machine, with the exception that address and data lines are monitored for the correct values.
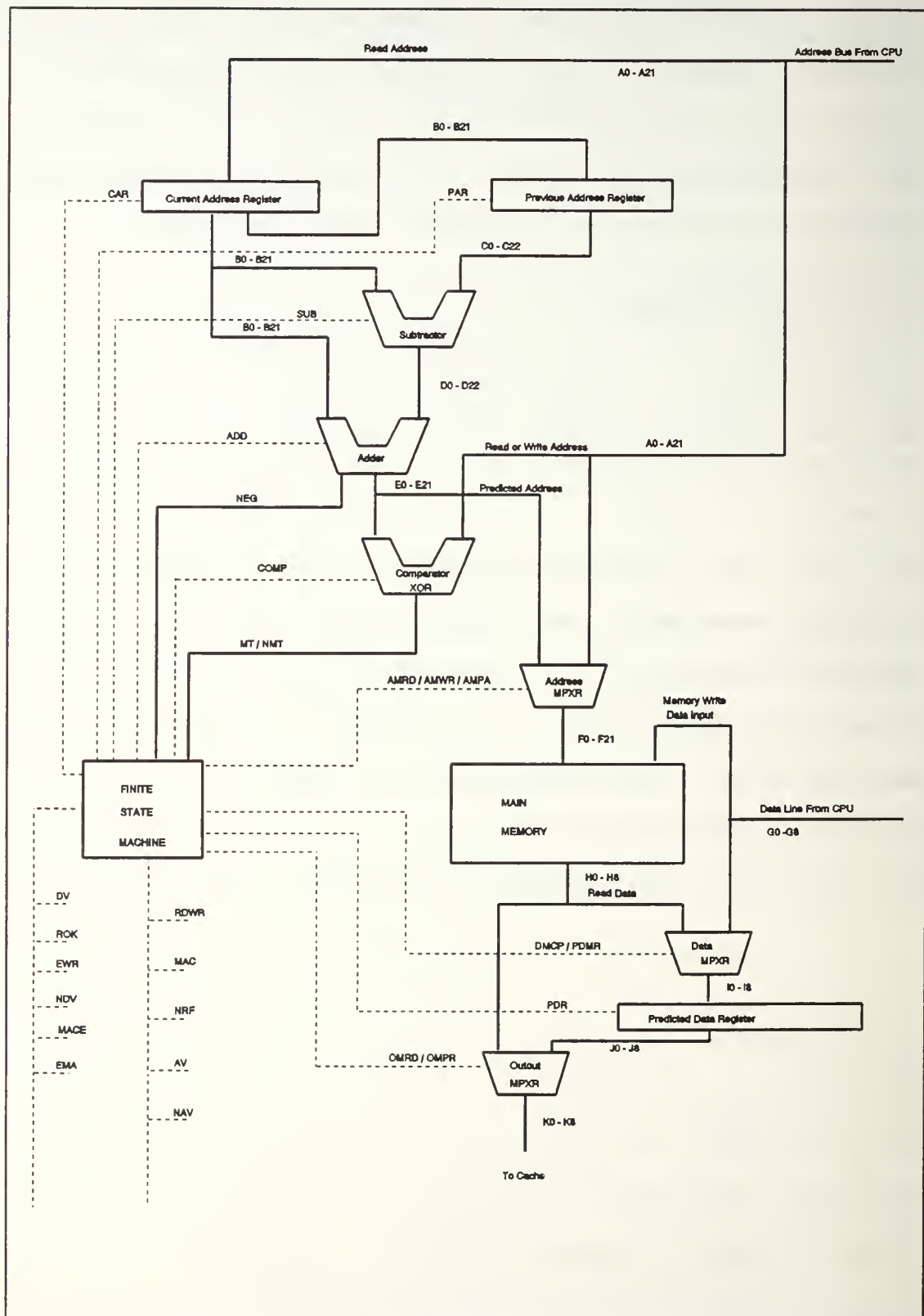
Figure 10.   Block Diagram Simulation Labels

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1) The RPB has been designed to be implemented on a single chip to work with a 4MEG by 9 bit memory module. Although the RPB uses a standard CMOS process, the functionality and algorithm implemented is a new contribution to memory subsystem technology.

2) Further testing or simulation is required in a working system in-order to determine the actual performance gains from this circuit. However, thesis research is currently being done to estimate the effects of the RPB on system-level performance by simulation. [Ref. 5]

B. RECOMMENDATIONS

1) Do an architectural study to more accurately determine performance improvements that the RPB can provide. [Ref. 5]

2) Put the RPB chip onto a memory module and test it out.

3) Design a DRAM Controller to implement the RPB and Refresh logic on a single chip.

4) Development of a 1-bit version of the RPB on new DRAM chip designs, so that systems can take advantage of this new innovation without making further modifications.

APPENDIX A.   FINITE STATE MACHINE DESIGN PRINTOUTS
PEG PROGRAM FOR FSM

```
-- PEG program for the Finite State Machine.
-- Read Prediction Buffer Thesis
-- Author : Gary J. Nowicki
-- Date Written : June 16 1992
-- Revision Date : Rev2 Sept. 4 1992


-- Program Filename : newfsm

INPUTS    :        RDWR AV NRF MAC NAV NMT MT RESET;

OUTPUTS:           NDV ROK EMA AMWR EWR DV AMRD CAR OMRD
                   PAR SUB ADD AMPA PDMR PDR DMCP COM OMPR
                   MACE;

s0        :        assert NDV ROK;
                   case (RDWR AV NRF)
                   0 1 1 => s1;
                   1 1 1 => s3;
                   endcase => LOOP;

s1        :        assert EMA AMWR EWR;
                   if MAC then s2 else LOOP;

s2        :        assert DV;
                   if NAV then s0 else LOOP;

s3        :        assert EMA AMRD CAR;
                   if MAC then s4 else LOOP;

s4        :        assert OMRD DV;
                   if NAV then s5 else LOOP;

s5        :        assert NDV ROK;
                   case (RDWR AV NRF)
                   0 1 1 => s6;
                   1 1 1 => s8;
                   endcase => LOOP;

s6        :        assert EMA AMWR EWR;
                   if MAC then s7 else LOOP;

s7        :        assert DV;
                   if NAV then s5 else LOOP;

s8        :        assert EMA AMRD PAR CAR;
                   if MAC then s9 else LOOP;

s9        :        assert OMRD DV SUB ADD;
                   if NAV then s10 else LOOP;

s10       :        assert EMA AMPA NDV;
                   if MAC then s11 else LOOP;

s11       :        assert PDMR PDR;
                   goto s12;
```

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```
s12     :       assert ROK;
                case (RDWR AV NRF)
                0 1 1 => s13;
                1 1 1 => s18;
                endcase => LOOP;

s13     :       assert EMA COM AMWR;
                case (NMT MT)
                1 0 => s14;
                0 1 => s15;
                endcase => LOOP;

s14     :       assert EWR;
                if MAC then s16 else LOOP;

s15     :       assert EWR DMCP PDR;
                if MAC then s16 else LOOP;

s16     :       assert DV;
                if NAV then s17 else LOOP;

s17     :       assert NDV;
                goto s12;

s18     :       assert AMRD COM CAR PAR;
                case (NMT MT)
                1 0 => s19;
                0 1 => s20;
                endcase => LOOP;

s19     :       assert EMA OMRD;
                if MAC then s21 else LOOP;

s20     :       assert DV OMPR MACE;
                if MAC then s21 else LOOP;

s21     :       assert SUB ADD DV;
                if NAV then s10 else LOOP;
```

PEG OUTPUT

```
INORDER=
  RDWR
  AV
  NRF
  MAC
  NAV
  NMT
  MT
  RESET
  InSt0*
  InSt1*
  InSt2*
  InSt3*
  InSt4*;
OUTORDER=
  OutSt4*
  OutSt3*
  OutSt2*
  OutSt1*
  OutSt0*
  NDV
  ROK
  EMA
  AMWR
  EWR
  DV
  AMRD
  CAR
  OMRD
  PAR
  SUB
  ADD
  AMPA
  PDMR
  PDR
  DMCP
  COM
  OMPR
  MACE;
OutSt4*=
    (!NAV&!RESET& InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    ( MAC&!RESET& InSt0*&!InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!RESET& InSt0*&!InSt1*&!InSt2*& InSt3*& InSt4*)|
    ( NMT&!MT&!RESET& InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
    ( NAV&!RESET& InSt0*&!InSt1*&!InSt2*&!InSt3*&!InSt4*)|
    (!MAC&!RESET&!InSt0*& InSt1*& InSt2*& InSt3*& InSt4*)|
    ( MT&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!NMT&!MT&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!RDWR& AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    ( MAC&!RESET&!InSt0*& InSt1*&!InSt2*&!InSt4*)|
    (!NAV&!RESET&!InSt0*& InSt1*&!InSt2*&!InSt3*& InSt4*)|
    (!RESET&!InSt0*&!InSt1*& InSt2*& InSt3*& InSt4*)|
    ( MAC&!RESET&!InSt0*&!InSt1*& InSt2*& InSt3*&!InSt4*)|
    (!AV& NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    ( NAV&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!MAC&!RESET&!InSt0*&!InSt1*&!InSt2*& InSt4*)|
```

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```
    ( AV& NRF&!RESET&!InSt0*&!InSt1*&!InSt2*&!InSt3*&!InSt4*);
OutSt3*=
    ( NAV&!RESET& InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!MAC&!RESET&!InSt1*&!InSt2*& InSt3*& InSt4*)|
    ( NMT&!RESET& InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
    (!NMT&!MT&!RESET& InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
    (!MAC&!RESET&!InSt0*& InSt1*& InSt2*& InSt3*)|
    (!NMT& MT&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
    ( NMT&!MT&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
    ( RDWR& AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!RESET&!InSt0*& InSt1*&!InSt2*& InSt3*&!InSt4*)|
    ( NAV&!RESET&!InSt0*& InSt1*&!InSt2*&!InSt3*& InSt4*)|
    (!NAV&!RESET&!InSt0*&!InSt1*& InSt2*& InSt3*& InSt4*)|
    (!RESET&!InSt0*&!InSt1*& InSt2*& InSt3*&!InSt4*)|
    (!RDWR& AV& NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!NAV&!RESET&!InSt0*&!InSt1*& InSt2*& InSt3*&!InSt4*)|
    ( MAC&!RESET&!InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*)|
    ( RDWR& AV& NRF&!RESET&!InSt0*&!InSt1*&!InSt2*&!InSt3*&!InSt4*);
OutSt2*=
    (!NAV&!RESET& InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!RESET&!InSt1*& InSt2*&!InSt3*&!InSt4*)|
    ( MAC&!RESET&!InSt1*&!InSt2*& InSt3*& InSt4*)|
    (!NMT& MT&!RESET& InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
    (!RESET& InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*)|
    (!MAC&!RESET&!InSt0*& InSt1*& InSt2*& InSt3*)|
    (!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!RDWR& AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!RESET&!InSt0*& InSt1*&!InSt2*& InSt3*& InSt4*)|
    (!RESET&!InSt0*&!InSt1*& InSt2*& InSt3*)|
    (!RDWR& AV& NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!AV& NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*);
OutSt1*=
    ( NAV&!RESET& InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!RESET& InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*)|
    (!MAC&!RESET&!InSt0*& InSt1*& InSt2*& InSt3*)|
    (!RESET&!InSt0*& InSt1*&!InSt3*& InSt4*)|
    (!RDWR& AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!RESET&!InSt0*& InSt1*&!InSt2*& InSt3*)|
    (!RESET&!InSt0*& InSt1*&!InSt2*&!InSt3*&!InSt4*)|
    ( RDWR& AV& NRF&!RESET&!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*);
OutSt0*=
    (!NAV&!RESET& InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!RESET& InSt0*&!InSt1*&!InSt3*&!InSt4*)|
    (!RESET& InSt0*&!InSt1*&!InSt2*& InSt3*)|
    ( MAC&!RESET&!InSt0*& InSt1*& InSt2*& InSt3*)|
    ( RDWR& AV& NRF&!RESET&!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*);
NDV=
    ( InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*)|
    (!InSt0*& InSt1*&!InSt2*& InSt3*&!InSt4*)|
    (!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!InSt0*&!InSt1*&!InSt2*&!InSt3*&!InSt4*);
ROK=
    (!InSt0*& InSt1*& InSt2*&!InSt3*&!InSt4*)|
    (!InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
    (!InSt0*&!InSt1*&!InSt2*&!InSt3*&!InSt4*);
EMA=
    (!InSt1*&!InSt2*& InSt3*& InSt4*)|
```

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```
        (!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt4*)|
        (!InSt0*&!InSt1*& InSt2*& InSt3*&!InSt4*)|
        (!InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*);
AMWR=
        (!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*)|
        (!InSt0*&!InSt1*& InSt2*& InSt3*&!InSt4*)|
        (!InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*);
EWR=
        (!InSt0*& InSt1*& InSt2*& InSt3*)|
        (!InSt0*&!InSt1*& InSt2*& InSt3*&!InSt4*)|
        (!InSt0*&!InSt1*&!InSt2*&!InSt3*& InSt4*);
DV=
        ( InSt0*&!InSt1*& InSt2*&!InSt3*)|
        ( InSt0*&!InSt1*&!InSt2*&!InSt3*&!InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt3*& InSt4*)|
        (!InSt0*&!InSt1*& InSt2*& InSt3*& InSt4*)|
        (!InSt0*&!InSt1*& InSt2*&!InSt3*&!InSt4*)|
        (!InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*);
AMRD=
        ( InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt3*&!InSt4*)|
        (!InSt0*&!InSt1*&!InSt2*& InSt3*& InSt4*);
CAR=
        ( InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt3*&!InSt4*)|
        (!InSt0*&!InSt1*&!InSt2*& InSt3*& InSt4*);
OMRD=
        ( InSt0*&!InSt1*&!InSt2*& InSt3*& InSt4*)|
        (!InSt0*& InSt1*&!InSt2*& InSt3*& InSt4*)|
        (!InSt0*&!InSt1*& InSt2*&!InSt3*&!InSt4*);
PAR=
        ( InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt3*&!InSt4*);
SUB=
        ( InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt3*& InSt4*);
ADD=
        ( InSt0*&!InSt1*& InSt2*&!InSt3*& InSt4*)|
        (!InSt0*& InSt1*&!InSt2*&!InSt3*& InSt4*);
AMPA=
        (!InSt0*& InSt1*&!InSt2*& InSt3*&!InSt4*);
PDMR=
        (!InSt0*& InSt1*&!InSt2*& InSt3*& InSt4*);
PDR=
        (!InSt0*& InSt1*& InSt3*& InSt4*);
DMCP=
        (!InSt0*& InSt1*& InSt2*& InSt3*& InSt4*);
COM=
        ( InSt0*&!InSt1*&!InSt2*& InSt3*&!InSt4*)|
        (!InSt0*& InSt1*& InSt2*&!InSt3*& InSt4*);
OMPR=
        ( InSt0*&!InSt1*& InSt2*&!InSt3*&!InSt4*);
MACE=
        ( InSt0*&!InSt1*& InSt2*&!InSt3*&!InSt4*);
```
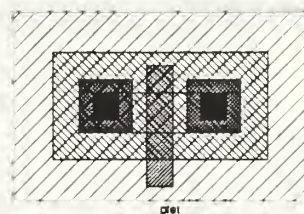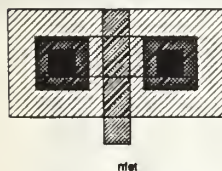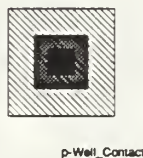
```
--------00000  0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------00001  0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---0---0000-1  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----0--000010  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------00010  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---------0011  0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---0---0-0011  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------00011  0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0
--------00100  0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0
-------0-0100  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--0---000101   1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------00101  0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------00110  0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------000110  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------00011-  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------000111  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------00111  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---0--000111   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------001000  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------010-0  0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------01000  0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 0 0
--------01001  0 0 0 0 0 0 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 0 0 0
---0--001001   1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------001-01  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------01010  0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
-------00101-  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------001010  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------01-11  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
--------01011  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0
-------001011  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--0---001100   0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------01100  0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------001101  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-----00001101  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------01101  0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
---0---00111-  0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------0111-  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------01111  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
---0--001111   1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------010-00  0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------10000  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------10001  0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------010001  0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-----00010010  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-------01001-  0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------10010  0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 0 0 0 0 1 0 0 0
--------10011  0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
-------010011  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------1010-  0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------10100  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1
---0--010101   1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
--------10101  0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0
----01001101   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-----1001101   1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----01010010   0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----10001101   0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----10010010   1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-----1-010010  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```
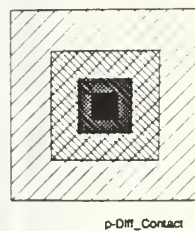
```
----1--000100  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----1--001001  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----1--010000  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
----1--010101  0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---1---000001  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---1---0-0011  0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---1---000110  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---1---0010-0  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---1---00111-  0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
---1---010100  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-01----000101  1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-01----001100  0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
-11----000000  1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
011----000101  0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
011----001100  1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
111----000000  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
111----000101  0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
111----001100  0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

APPENDIX B.   BASIC CELL LAYOUTS

A.   MAGIC LEGEND FOR LAYOUTS

n-Well

p-Diffusion

n-Well_Contact

Metal1

Metal1-Metal2_Contact

Poly-Metal1_Contact

p-Diff_Contact

Metal2

Polysilicon

p-Well_Contact

n-Diff_Contact

n-Diffusion

nfet

pfet

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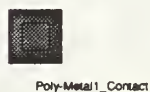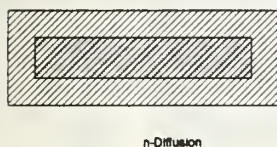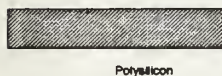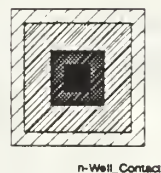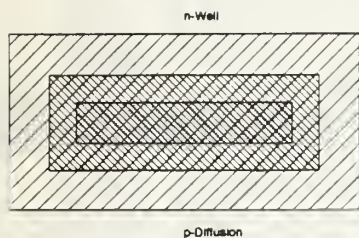
B.   BASIC REGISTER LAYOUT
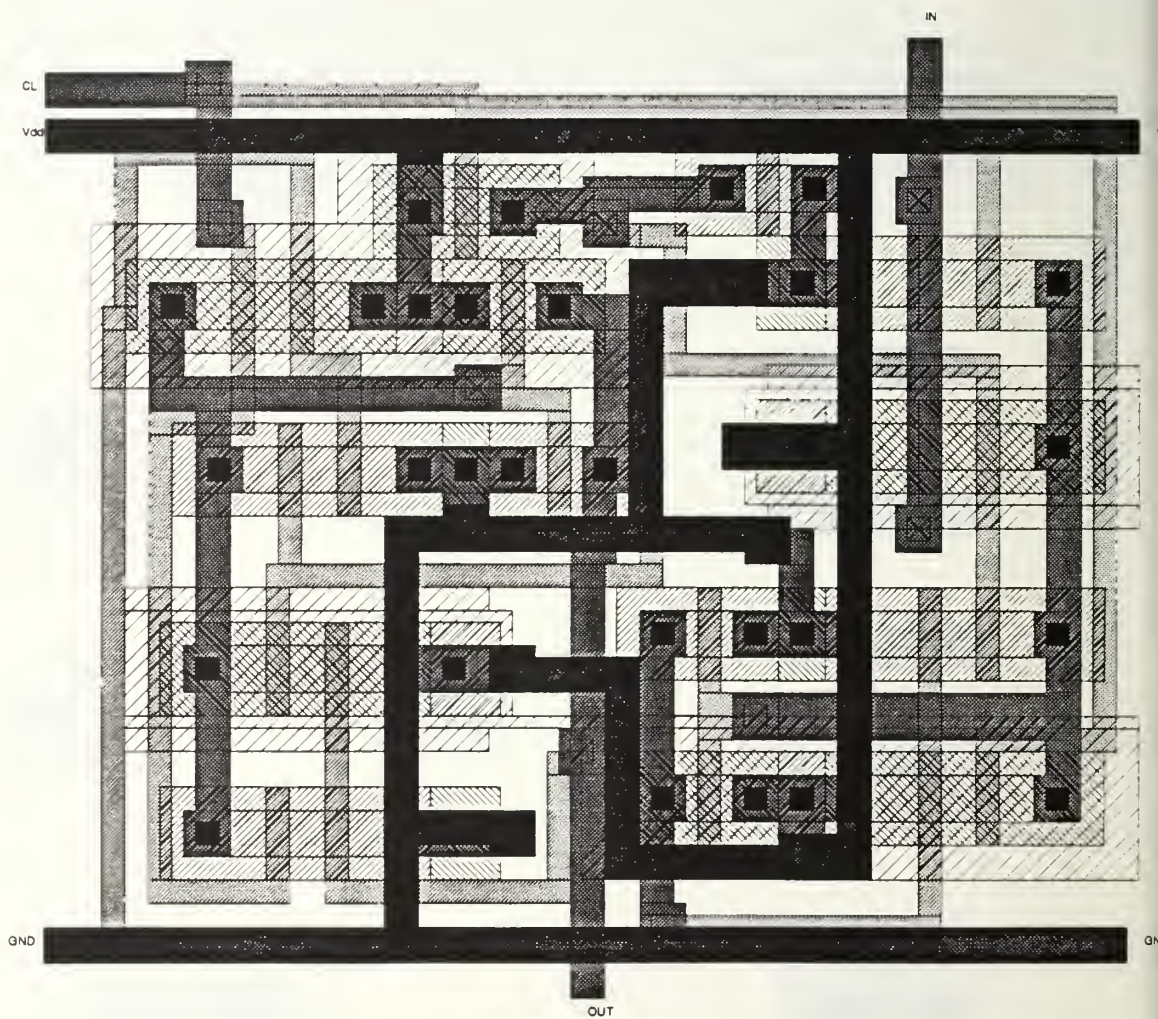
1. Two's Compliment Register
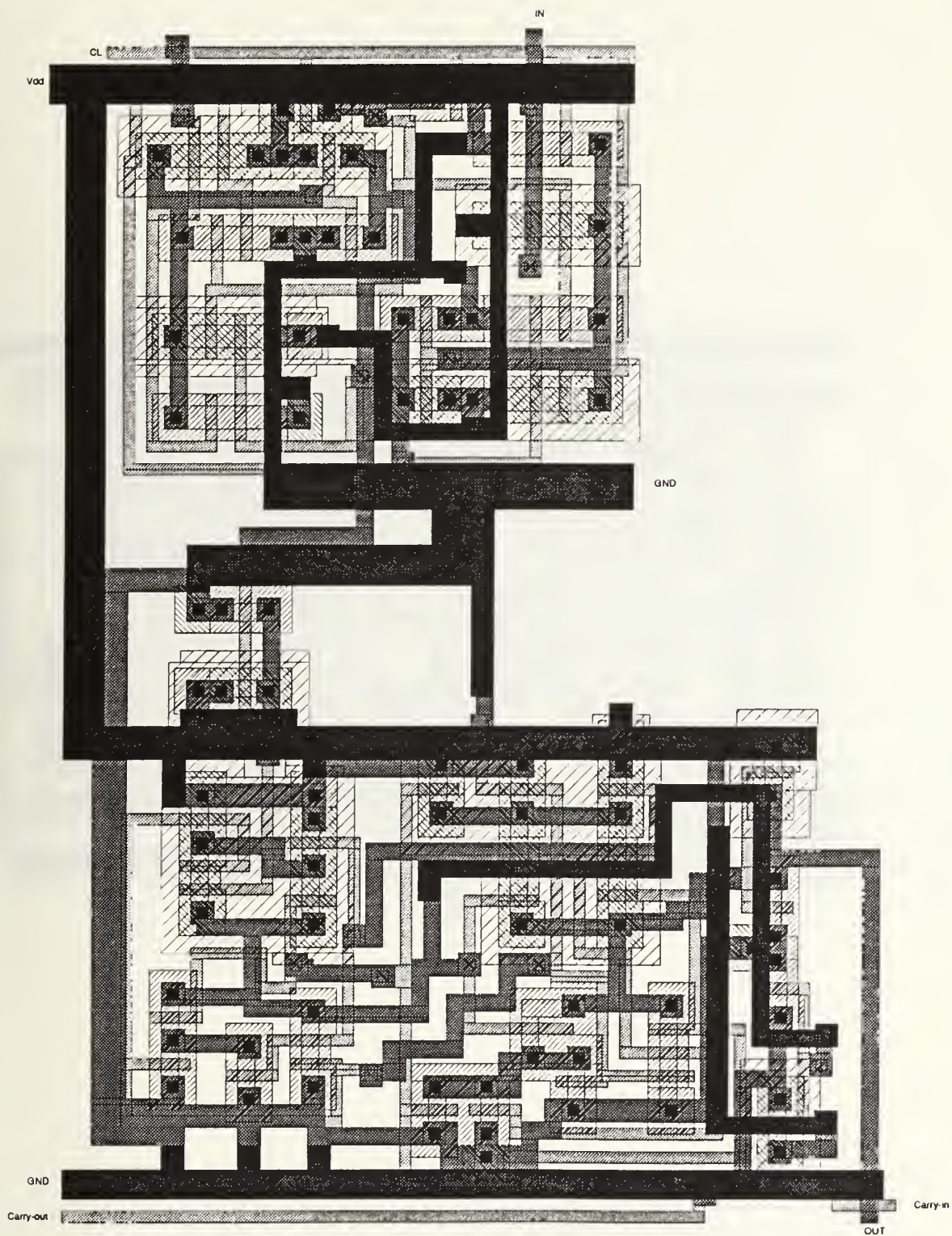
C.   BASIC ADDER LAYOUT
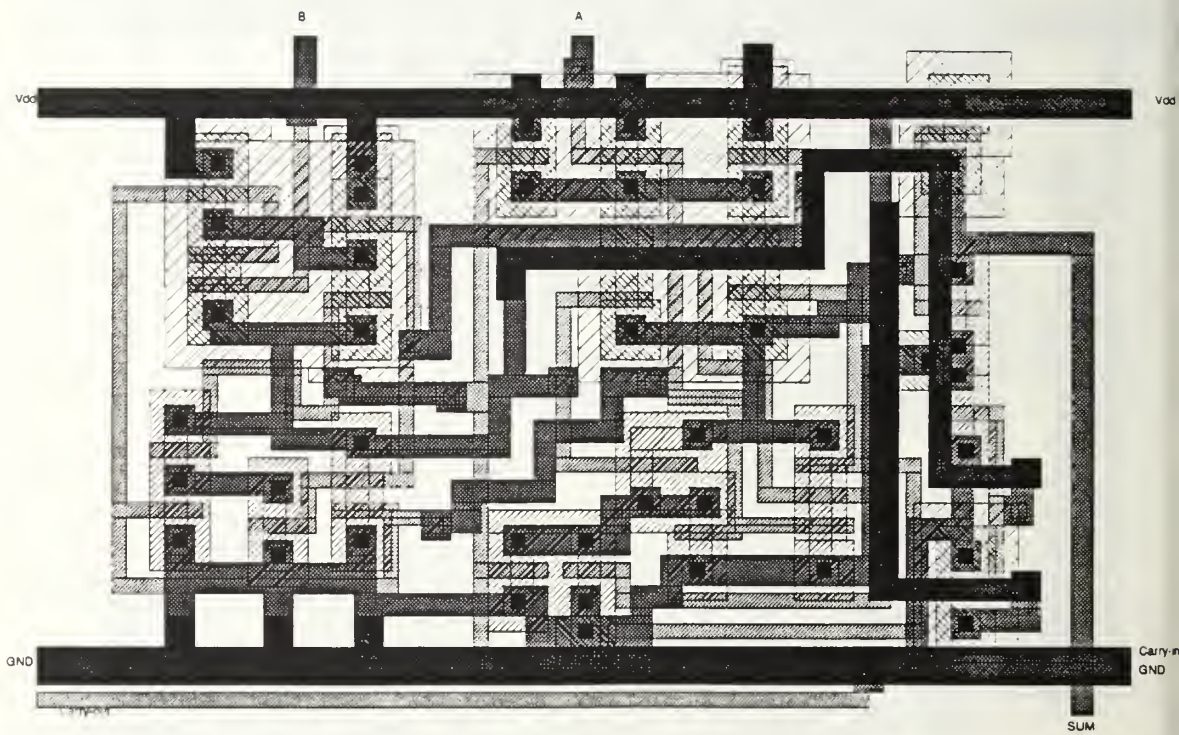
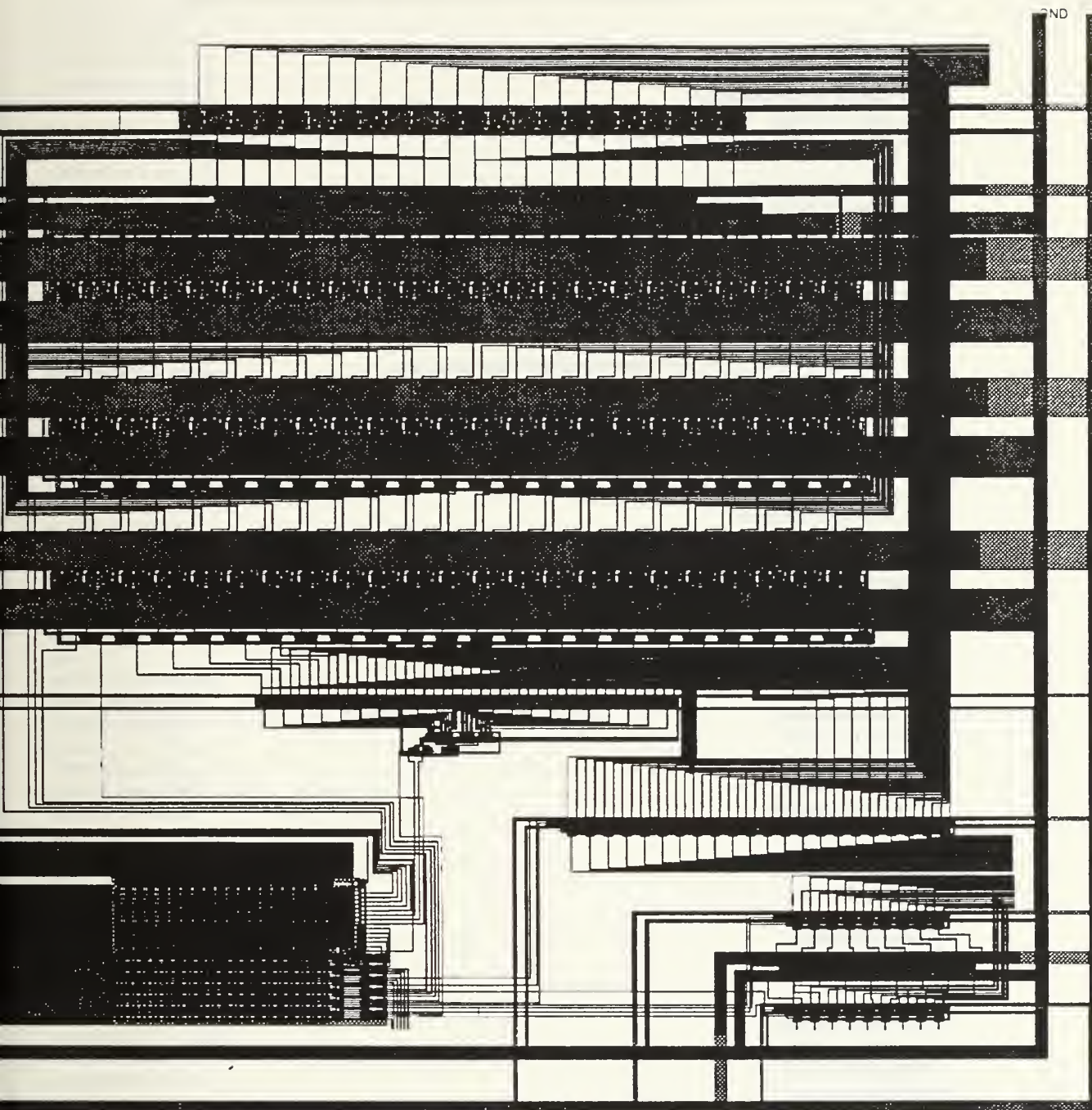# D. BASIC COMPARATOR LAYOUT
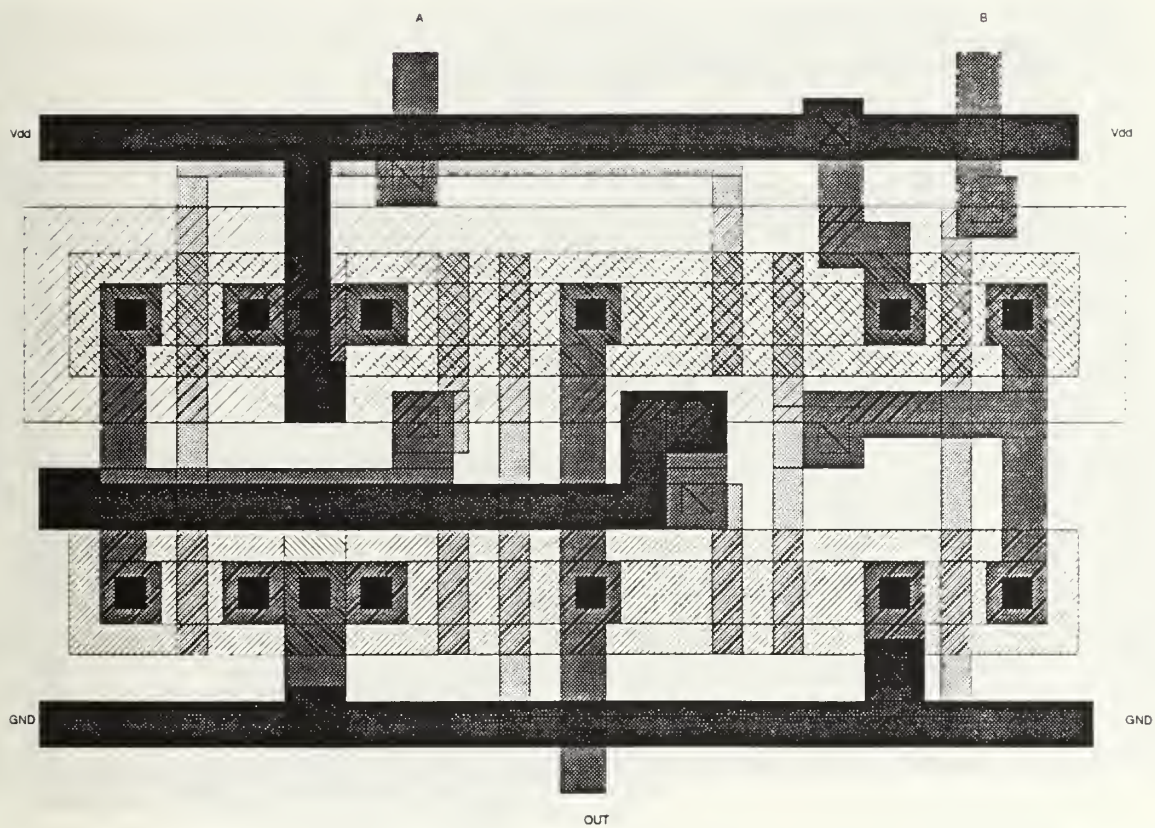
E. BASIC MULTIPLEXER LAYOUT
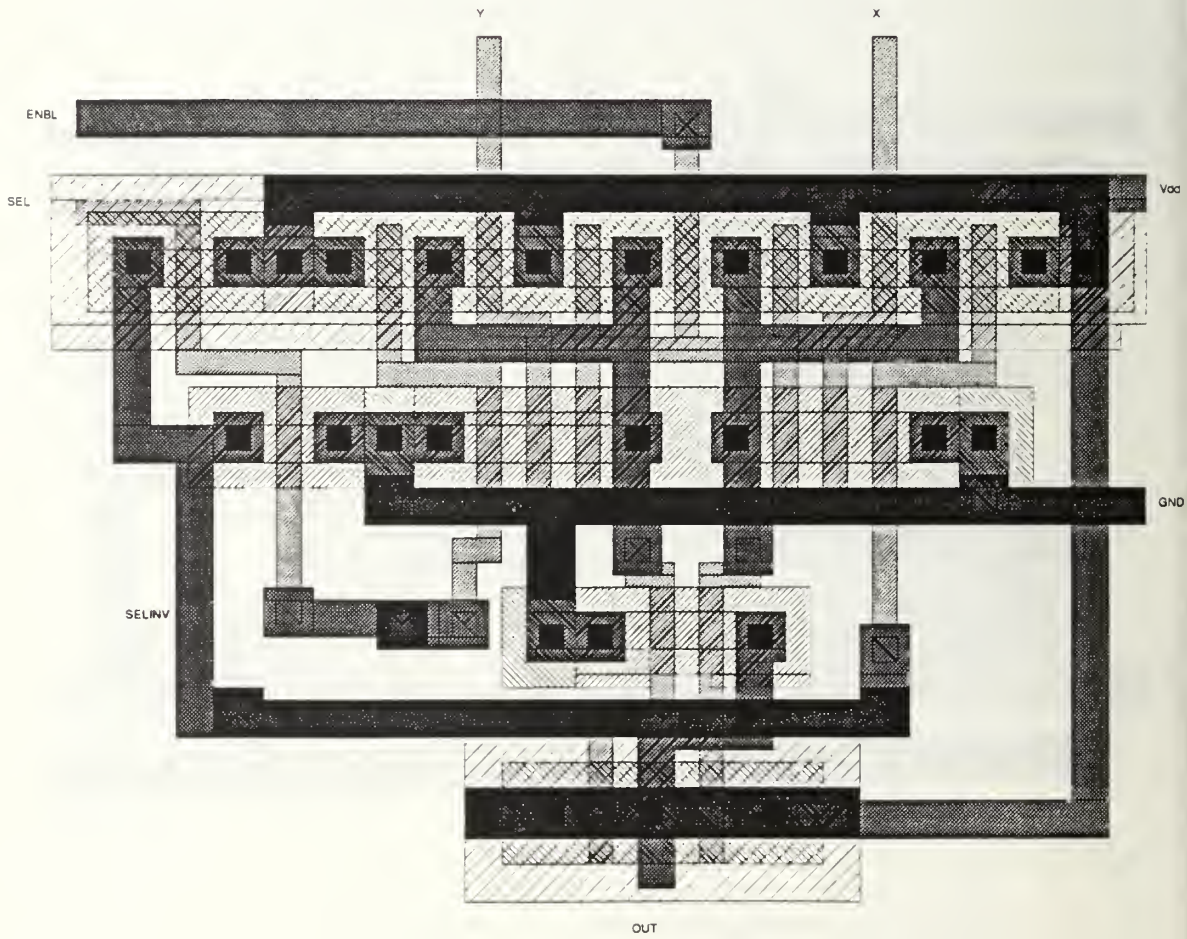
F. FINITE STATE MACHINE

G. RPB FLOOR PLAN

```
Current Address Register
```

```
Previous Address Register
```

```
Subtractor
```

```
Adder
```

```
Comparator
```

```
Address Multiplexer
```

```
Data Multiplexer
```

```
Finite State Machine
```

```
Predicted Data Register
```

```
Output Multiplexer
```
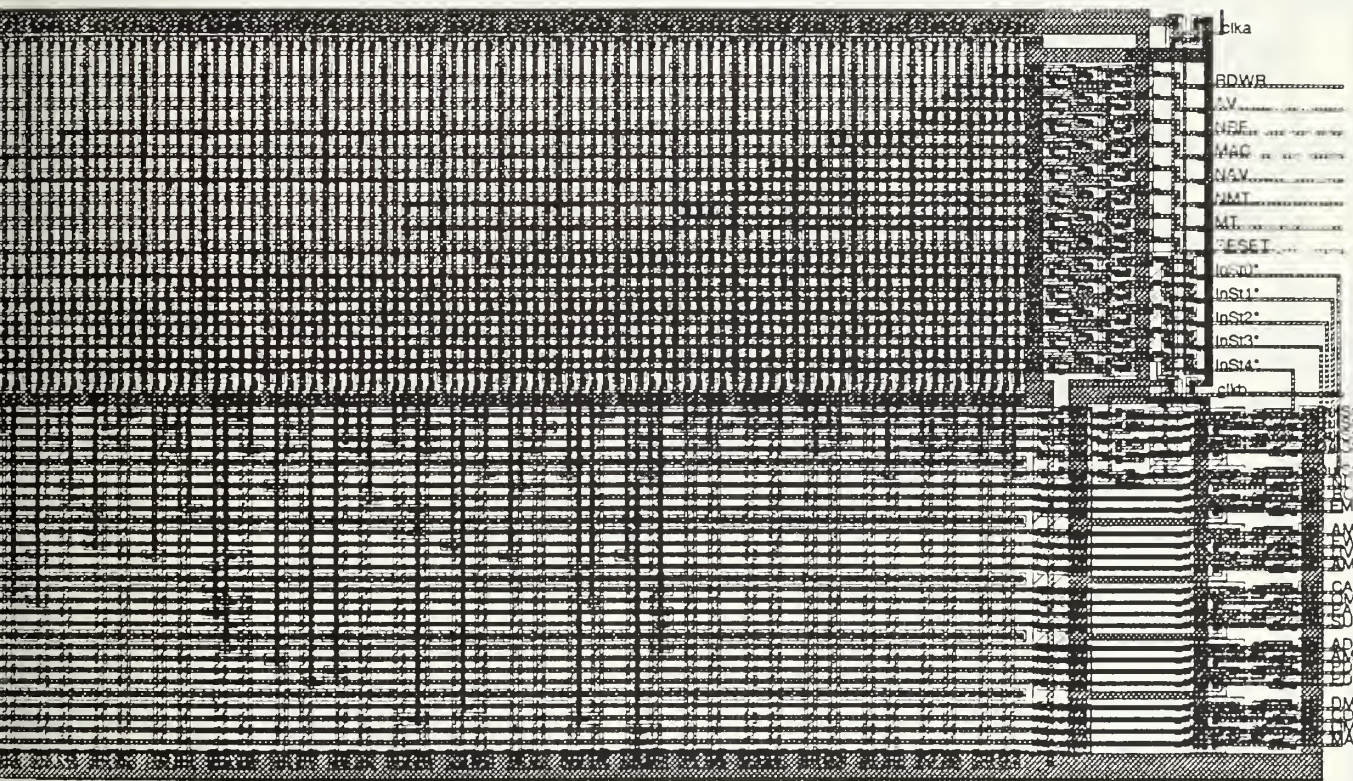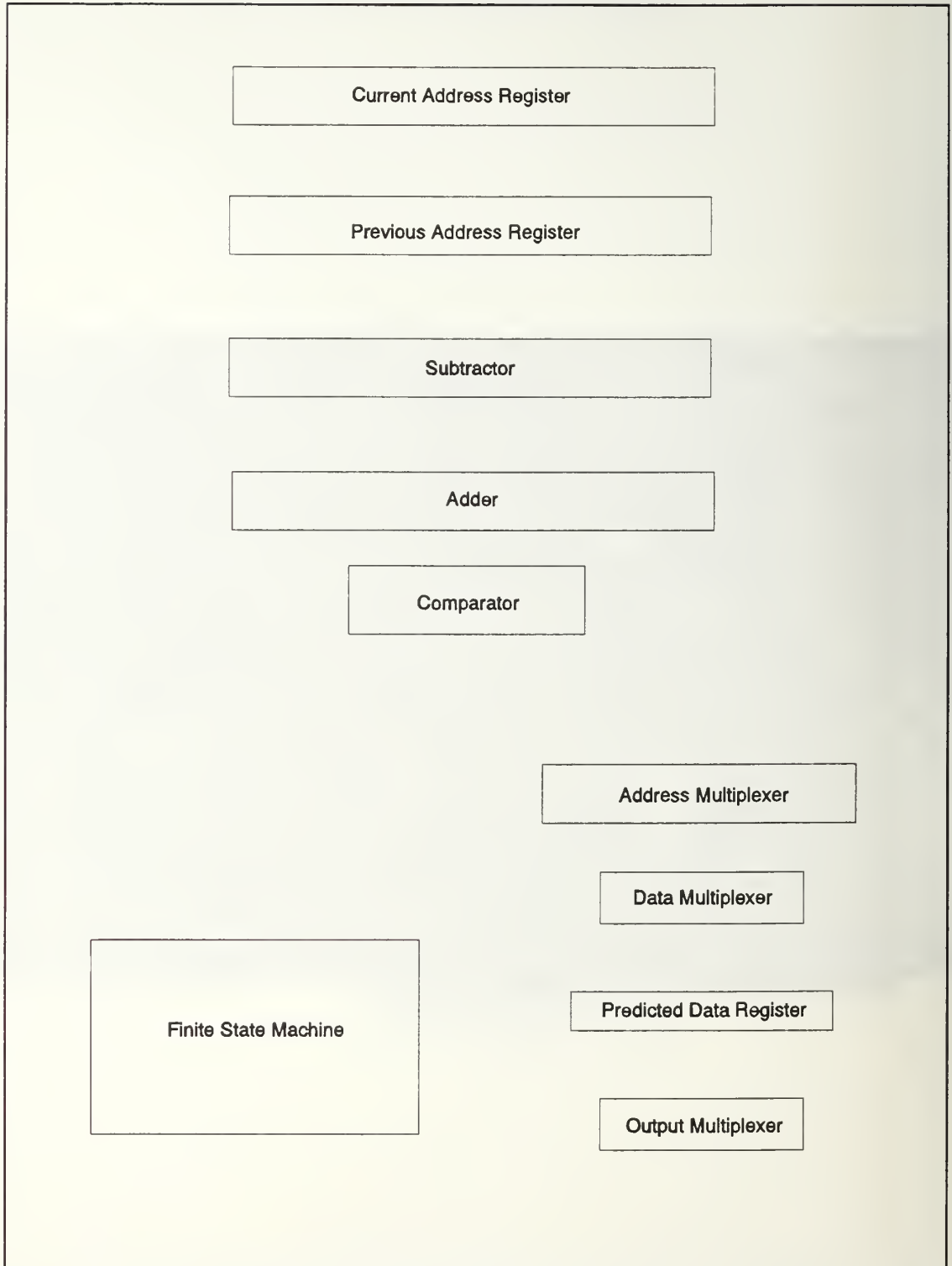
H.   READ PREDICTION BUFFER

APPENDIX C.   SIMULATION DATA

A. FINITE STATE MACHINE ESIM OUTPUT

```
sun17:/home3/nowicki/thesis/FSM
% ext2sim newfsmpla
Memory used: 242k

sun17:/home3/nowicki/thesis/FSM
% esim newfsmpla.sim
ESIM (V3.5 03/27/91)
703 transistors, 174 nodes (100 pulled up)
sim> I
initialization took 395 steps
sim> I
initialization took 0 steps
sim> w RDWR AV NRF MAC NAV NMT MT RESET NDV ROK EMA
     AMWR EWR DV AMRD CAR OMRD PAR SUB ADD
     AMPA PDMR PDR DMCP COM OMPR MACE clka clkb
sim> I Set up clock
sim> V clka 110000
sim> V clkb 000110
sim> I Simulations will be for 12 clock pulses
sim> I Start-state 0 (00000)
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 1 (00001)
sim> V AV 11
sim> V NRF 11
sim> G 12
```

```
>000000000000:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 2 (00010)
sim> V AV 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>111111000000:AMWR
>111111000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
```

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```
>000110000110:clkb
sim> | Back to State 0
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | To State 3 (00011)
sim> V NAV 00
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>111111111111:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000111111:AMRD
>000000111111:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
```

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```
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 4 (00100)
sim> V AV 00
sim> V RDWR 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000111111:DV
>111111000000:AMRD
>111111000000:CAR
>000000111111:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 5 (00101)
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
```

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```
>111111000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | To State 6 (00110)
sim> V NAV 00
sim> V AV 11
sim> V NRF 11
sim> G 12
>000000000000:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | To State 7 (00111)
sim> V AV 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
```

```
>111111000000:EMA
>111111000000:AMWR
>111111000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Back to State 5 (00101)
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l To State 8 (01000)
sim> V NAV 00
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>111111111111:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
```

```
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000111111:AMRD
>000000111111:CAR
>000000000000:OMRD
>000000111111:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 9 (01001)
sim> V RDWR 00
sim> V AV 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000111111:DV
>111111000000:AMRD
>111111000000:CAR
>000000111111:OMRD
>111111000000:PAR
>000000111111:SUB
>000000111111:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 10 (01010)
sim> V MAC 00
```

```
sim> V NAV 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>111111000000:OMRD
>000000000000:PAR
>111111000000:SUB
>111111000000:ADD
>000000111111:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 11 (01011)
sim> V NAV 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>111111000000:AMPA
>000000111111:PDMR
>000000111111:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
```

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```
>110000110000:clka
>000110000110:clkb
sim> I To State 12 (01100)
sim> V MAC 00
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 13 (01101)
sim> V AV 11
sim> V NRF 11
sim> G 12
>000000000000:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
```

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```
>000000111111:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 14 (01110)
sim> V AV 00
sim> V NRF 00
sim> V NMT 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>111111111111:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>111111000000:AMWR
>000000111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>111111000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 16 (10000)
sim> V NMT 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>111111000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
```

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```
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 17 (10001)
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I Back to State 12 (01100)
sim> V NAV 00
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
```

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```
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 13 (01101)
sim> V AV 11
sim> V NRF 11
sim> G 12
>000000000000:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000111111:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 15 (01111)
sim> V AV 00
sim> V NRF 00
sim> V MT 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>111111111111:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
```

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```
>111111000000:AMWR
>000000111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000111111:PDR
>000000111111:DMCP
>111111000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 16 (10000)
sim> V MT 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>111111000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>111111000000:PDR
>111111000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 17 (10001)
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
```

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```
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Back to State 12 (01100)
sim> V NAV 00
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l To State 18 (10010)
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>111111111111:RDWR
>111111111111:AV
>111111111111:NRF
```

```
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000111111:AMRD
>000000111111:CAR
>000000000000:OMRD
>000000111111:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000111111:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 19 (10011)
sim> V RDWR 00
sim> V AV 00
sim> V NRF 00
sim> V NMT 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>111111111111:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>111111000000:AMRD
>111111000000:CAR
>000000111111:OMRD
>111111000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>111111000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 21 (10101)
```

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```
sim> V NMT 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>111111000000:OMRD
>000000000000:PAR
>000000111111:SUB
>000000111111:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 10 (01010)
sim> V NAV 11
sim> V MAC 00
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>111111000000:SUB
>111111000000:ADD
>000000111111:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
```

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```
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 11 (01011)
sim> V NAV 00
sim> V MAC 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>111111000000:AMPA
>000000111111:PDMR
>000000111111:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 12 (01100)
sim> V MAC 00
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
```

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```
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 13 (10010)
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>111111111111:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000111111:AMRD
>000000111111:CAR
>000000000000:OMRD
>000000111111:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000111111:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 20 (10100)
sim> V RDWR 00
sim> V AV 00
sim> V NRF 00
sim> V MT 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>111111111111:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000111111:DV
>111111000000:AMRD
>111111000000:CAR
```

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```
>000000000000:OMRD
>111111000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>111111000000:COM
>000000111111:OMPR
>000000111111:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 21 (10101)
sim> V MT 00
sim> V MAC 11
sim>  G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000111111:SUB
>000000111111:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>111111000000:OMPR
>111111000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I Check RESET to State 0 (00000)
sim> V MAC 00
sim> V RESET 11
sim> G 12
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>111111111111:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
```

```
>00000000000:EWR
>111111000000:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>111111000000:SUB
>111111000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 1 (00001)
sim> V RESET 00
sim> V AV 111
sim> V NRF 11
sim> G 12
>00000000000:RDWR
>111111111111:AV
>111111111111:NRF
>00000000000:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000111111:EWR
>00000000000:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> quit
```

B. READ PREDICTION BUFFER CIRCUIT ESIM OUTPUT

Script started on Wed Sep 2 10:54:41 1992

sun17:/home3/nowicki/thesis/DONE/TEST
% ext2sim RPB
Memory used: 1802k

sun17:/home3/nowicki/thesis/DONE/TEST
% esim RPB.sim
ESIM (V3.5 03/27/91)
5036 transistors, 2548 nodes (149 pulled up)
sim> I
I
initialization took 8435 steps
sim> initialization took 495 steps
sim> I
initialization took 286 steps
sim> I Patchfile watches all input and output nodes
sim> @ patchfile.sim
sim> I Set up clock pulses for FSM
sim> V clka 110000
sim> V clkb 000110
sim> G 12
>000000000000:A0
>000000000000:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>000000000000:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13

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```
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>11111111111:C0
>00000000000:C1
>XXXXXXXXXXX:C2
>00000000000:C3
>XXXXXXXXXXX:C4
>XXXXXXXXXXX:C5
>XXXXXXXXXXX:C6
>XXXXXXXXXXX:C7
>00000000000:C8
>00000000000:C9
>00000000000:C10
>XXXXXXXXXXX:C11
>00000000000:C12
>XXXXXXXXXXX:C13
>XXXXXXXXXXX:C14
>00000000000:C15
>11111111111:C16
>00000000000:C17
>11111111111:C18
>XXXXXXXXXXX:C19
>XXXXXXXXXXX:C20
>00000000000:C21
>11111111111:C22
>11111111111:D0
>00000000000:D1
>XXXXXXXXXXX:D2
>00000000000:D3
>XXXXXXXXXXX:D4
>XXXXXXXXXXX:D5
>XXXXXXXXXXX:D6
>XXXXXXXXXXX:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>XXXXXXXXXXX:D11
>00000000000:D12
>XXXXXXXXXXX:D13
>XXXXXXXXXXX:D14
>00000000000:D15
>11111111111:D16
>00000000000:D17
>11111111111:D18
>XXXXXXXXXXX:D19
>XXXXXXXXXXX:D20
>00000000000:D21
>11111111111:D22
>00000000000:E0
>00000000000:E1
>11111111111:E2
>00000000000:E3
>00000000000:E4
>11111111111:E5
>11111111111:E6
>11111111111:E7
```

```
>00000000000:E8
>11111111111:E9
>00000000000:E10
>XXXXXXXXXXXX:E11
>00000000000:E12
>11111111111:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>11111111111:E17
>11111111111:E18
>00000000000:E19
>11111111111:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>00000000000:G4
>00000000000:G5
>00000000000:G6
>00000000000:G7
>00000000000:G8
>00000000000:H0
>00000000000:H1
>00000000000:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
```

```
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111111111:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Set first Adrs to 1, and set read data and data line from CPU
sim> h A0 H0 H1 H2 G4 G5 G6
sim> l To State 1
sim> V AV 11
sim> V NRF 11
sim> G 12
>111111111111:A0
>000000000000:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
```

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```
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>00000000000:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>000G0000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>11111111111:C0
>00000000000:C1
>XXXXXXXXXXX:C2
>00000000000:C3
>XXXXXXXXXXX:C4
>XXXXXXXXXXX:C5
>XXXXXXXXXXX:C6
>XXXXXXXXXXX:C7
>00000000000:C8
>00000000000:C9
>00000000000:C10
>XXXXXXXXXXX:C11
>00000000000:C12
>XXXXXXXXXXX:C13
>XXXXXXXXXXX:C14
>00000000000:C15
>11111111111:C16
>00000000000:C17
>11111111111:C18
>XXXXXXXXXXX:C19
>XXXXXXXXXXX:C20
>00000000000:C21
>11111111111:C22
>11111111111:D0
>00000000000:D1
>XXXXXXXXXXX:D2
```

```
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
>000000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>000000111111:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
```

81

```
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>00000000000:J0
>00000000000:J1
>00000000000:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>11111111111:AV
>11111111111:NRF
>00000000000:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>11111100000:NDV
>11111100000:ROK
>00000011111:EMA
>00000011111:AMWR
>00000011111:EWR
>00000000000:DV
>00000000000:AMRD
```

```
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | To State 2
sim> V AV 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>111111111111:A0
>000000000000:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>000000000000:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
```

83

```
>000000000000:B21
>111111111111:C0
>000000000000:C1
>XXXXXXXXXXXX:C2
>000000000000:C3
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>000000000000:C8
>000000000000:C9
>000000000000:C10
>XXXXXXXXXXXX:C11
>000000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>000000000000:C15
>111111111111:C16
>000000000000:C17
>111111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>000000000000:C21
>111111111111:C22
>111111111111:D0
>000000000000:D1
>XXXXXXXXXXXX:D2
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
>000000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
```

```
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>111111000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
```

85

```
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>11111111111:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>00000000000:NDV
>00000000000:ROK
>11111000000:EMA
>11111000000:AMWR
>11111000000:EWR
>000000111111:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 0
sim> V MAC 00
sim> V NAV 11
sim> G 12
>11111111111:A0
>00000000000:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
```

86

```
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>000000000000:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>111111111111:C0
>000000000000:C1
>XXXXXXXXXXXX:C2
>000000000000:C3
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>000000000000:C8
>000000000000:C9
>000000000000:C10
>XXXXXXXXXXXX:C11
>000000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>000000000000:C15
>111111111111:C16
>000000000000:C17
>111111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>000000000000:C21
>111111111111:C22
>111111111111:D0
>000000000000:D1
>XXXXXXXXXXXX:D2
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
```

```
>00000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>00000000000:D15
>11111111111:D16
>00000000000:D17
>11111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>00000000000:D21
>11111111111:D22
>00000000000:E0
>00000000000:E1
>11111111111:E2
>00000000000:E3
>00000000000:E4
>11111111111:E5
>11111111111:E6
>11111111111:E7
>00000000000:E8
>11111111111:E9
>00000000000:E10
>XXXXXXXXXXXX:E11
>00000000000:E12
>11111111111:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>11111111111:E17
>11111111111:E18
>00000000000:E19
>11111111111:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
```

88

```
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
```

```
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l To State 3
sim> V NAV 00
sim> l Set Read Adrs to 2
sim> 1 A0
sim> h A1
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>00000000000:A0
>111111111111:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>00000000000:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>111111111111:C0
>00000000000:C1
>XXXXXXXXXXXX:C2
>00000000000:C3
```

90

```
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>000000000000:C8
>000000000000:C9
>000000000000:C10
>XXXXXXXXXXXX:C11
>000000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>000000000000:C15
>111111111111:C16
>000000000000:C17
>111111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>000000000000:C21
>111111111111:C22
>111111111111:D0
>000000000000:D1
>XXXXXXXXXXXX:D2
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
>000000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
```

```
>111111111111:E20
>000000000000:E21
>000000000000:F0
>000000111111:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
```

```
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>111111111111:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000111111:AMRD
>000000111111:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 4
sim> V AV 00
sim> V RDWR 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
```

```
>00000000000:A20
>00000000000:A21
>00000000000:B0
>000000111111:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>111111111111:C0
>00000000000:C1
>XXXXXXXXXXXX:C2
>00000000000:C3
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>00000000000:C8
>00000000000:C9
>00000000000:C10
>XXXXXXXXXXXX:C11
>00000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>00000000000:C15
>111111111111:C16
>00000000000:C17
>111111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>00000000000:C21
>111111111111:C22
>111111111111:D0
>00000000000:D1
>XXXXXXXXXXXX:D2
>00000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>XXXXXXXXXXXX:D11
>00000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
```

```
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>00000000000:E1
>11111111111:E2
>00000000000:E3
>00000000000:E4
>11111111111:E5
>11111111111:E6
>11111111111:E7
>00000000000:E8
>11111111111:E9
>00000000000:E10
>XXXXXXXXXXXX:E11
>00000000000:E12
>11111111111:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>11111111111:E17
>11111111111:E18
>00000000000:E19
>11111111111:E20
>00000000000:E21
>00000000000:F0
>11111000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
```

```
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000111111:K0
>000000111111:K1
>000000111111:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000111111:DV
>111111000000:AMRD
>111111000000:CAR
>000000111111:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
```

```
>110000110000:clka
>000110000110:clkb
sim> I To State 5
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>111111111111:C0
>000000000000:C1
>XXXXXXXXXXXX:C2
>000000000000:C3
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>000000000000:C8
>000000000000:C9
>000000000000:C10
>XXXXXXXXXXXX:C11
```

```
>000000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>000000000000:C15
>111111111111:C16
>000000000000:C17
>111111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>000000000000:C21
>111111111111:C22
>111111111111:D0
>000000000000:D1
>XXXXXXXXXXXX:D2
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
>000000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
```

```
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>111111000000:K0
>111111000000:K1
>111111000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
```

```
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>111111000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> V NAV 00
sim> | Set next Write Adrs to 3
sim> h A0
sim> | To State 6
sim> V AV 11
sim> V NRF 11
sim> G 12
>111111111111:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
```

```
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>11111111111:C0
>00000000000:C1
>XXXXXXXXXXXX:C2
>00000000000:C3
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>00000000000:C8
>00000000000:C9
>00000000000:C10
>XXXXXXXXXXXX:C11
>00000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>00000000000:C15
>11111111111:C16
>00000000000:C17
>11111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>00000000000:C21
>11111111111:C22
>11111111111:D0
>00000000000:D1
>XXXXXXXXXXXX:D2
>00000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>XXXXXXXXXXXX:D11
>00000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>00000000000:D15
>11111111111:D16
>00000000000:D17
>11111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>00000000000:D21
```

```
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>000000111111:F0
>000000111111:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
```

```
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 7
sim> V AV 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
```

```
>111111111111:A0
>111111111111:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>111111111111:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>111111111111:C0
>00000000000:C1
>XXXXXXXXXXXX:C2
>00000000000:C3
>XXXXXXXXXXXX:C4
>XXXXXXXXXXXX:C5
>XXXXXXXXXXXX:C6
>XXXXXXXXXXXX:C7
>00000000000:C8
>00000000000:C9
>00000000000:C10
>XXXXXXXXXXXX:C11
>00000000000:C12
>XXXXXXXXXXXX:C13
>XXXXXXXXXXXX:C14
>00000000000:C15
>111111111111:C16
>00000000000:C17
```

```
>111111111111:C18
>XXXXXXXXXXXX:C19
>XXXXXXXXXXXX:C20
>000000000000:C21
>111111111111:C22
>111111111111:D0
>000000000000:D1
>XXXXXXXXXXXX:D2
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
>000000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>111111000000:F0
>111111000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
```

```
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>00000000000:J0
>00000000000:J1
>00000000000:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>11111111111:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
```

```
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>111111000000:AMWR
>111111000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 5
sim> V MAC 00
sim> V NAV 11
sim> G 12
>111111111111:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
```

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```
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>11111111111:C0
>00000000000:C1
>XXXXXXXXXXX:C2
>00000000000:C3
>XXXXXXXXXXX:C4
>XXXXXXXXXXX:C5
>XXXXXXXXXXX:C6
>XXXXXXXXXXX:C7
>00000000000:C8
>00000000000:C9
>00000000000:C10
>XXXXXXXXXXX:C11
>00000000000:C12
>XXXXXXXXXXX:C13
>XXXXXXXXXXX:C14
>00000000000:C15
>11111111111:C16
>00000000000:C17
>11111111111:C18
>XXXXXXXXXXX:C19
>XXXXXXXXXXX:C20
>00000000000:C21
>11111111111:C22
>11111111111:D0
>00000000000:D1
>XXXXXXXXXXX:D2
>00000000000:D3
>XXXXXXXXXXX:D4
>XXXXXXXXXXX:D5
>XXXXXXXXXXX:D6
>XXXXXXXXXXX:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>XXXXXXXXXXX:D11
>00000000000:D12
>XXXXXXXXXXX:D13
>XXXXXXXXXXX:D14
>00000000000:D15
>11111111111:D16
>00000000000:D17
>11111111111:D18
>XXXXXXXXXXX:D19
>XXXXXXXXXXX:D20
>00000000000:D21
>11111111111:D22
>00000000000:E0
>00000000000:E1
>11111111111:E2
>00000000000:E3
>00000000000:E4
>11111111111:E5
>11111111111:E6
>11111111111:E7
```

```
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
```

```
>00000000000:I8
>00000000000:J0
>00000000000:J1
>00000000000:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>00000000000:MAC
>11111111111:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>000000111111:NDV
>000000111111:ROK
>00000000000:EMA
>00000000000:AMWR
>00000000000:EWR
>111111000000:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> V NAV 00
sim> I Set Read Adrs to 10
sim> l A0
sim> h A3
sim> I To State 8
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>00000000000:A0
>11111111111:A1
>00000000000:A2
>11111111111:A3
>00000000000:A4
```

```
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>111111000000:C0
>000000111111:C1
>XXXXXX111111:C2
>000000111111:C3
>XXXXXX111111:C4
>XXXXXX111111:C5
>XXXXXX111111:C6
>XXXXXX111111:C7
>000000111111:C8
>000000111111:C9
>000000111111:C10
>XXXXXX111111:C11
>000000111111:C12
>XXXXXX111111:C13
>XXXXXX111111:C14
>000000111111:C15
>111111111111:C16
>000000111111:C17
>111111111111:C18
>XXXXXX111111:C19
>XXXXXX111111:C20
>000000111111:C21
>111111111111:C22
```

```
>111111111111:D0
>000000000000:D1
>XXXXXXXXXXXX:D2
>000000000000:D3
>XXXXXXXXXXXX:D4
>XXXXXXXXXXXX:D5
>XXXXXXXXXXXX:D6
>XXXXXXXXXXXX:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXXXXXXXX:D11
>000000000000:D12
>XXXXXXXXXXXX:D13
>XXXXXXXXXXXX:D14
>000000000000:D15
>111111111111:D16
>000000000000:D17
>111111111111:D18
>XXXXXXXXXXXX:D19
>XXXXXXXXXXXX:D20
>000000000000:D21
>111111111111:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>000000000000:E3
>000000000000:E4
>111111111111:E5
>111111111111:E6
>111111111111:E7
>000000000000:E8
>111111111111:E9
>000000000000:E10
>XXXXXXXXXXXX:E11
>000000000000:E12
>111111111111:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>111111111111:E17
>111111111111:E18
>000000000000:E19
>111111111111:E20
>000000000000:E21
>000000000000:F0
>000000111111:F1
>000000000000:F2
>000000111111:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
```

```
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>111111111111:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>111111000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000000000:AMWR
```

```
>00000000000:EWR
>00000000000:DV
>000000111111:AMRD
>000000111111:CAR
>00000000000:OMRD
>000000111111:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 9
sim> V RDWR 00
sim> V AV 00
sim> V NRF 00
sim> V MAC 11
sim> G 12
>00000000000:A0
>111111111111:A1
>00000000000:A2
>111111111111:A3
>00000000000:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>111111111111:B1
>00000000000:B2
>000000111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
```

114

```
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>111111000000:D0
>000000000000:D1
>XXXXXX000000:D2
>000000111111:D3
>XXXXXX000000:D4
>XXXXXX000000:D5
>XXXXXX000000:D6
>XXXXXX000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>XXXXXX000000:D11
>000000000000:D12
>XXXXXX000000:D13
>XXXXXX000000:D14
>000000000000:D15
>111111000000:D16
>000000000000:D17
>111111000000:D18
>XXXXXX000000:D19
>XXXXXX000000:D20
>000000000000:D21
>111111000000:D22
>000000000000:E0
>000000111111:E1
>111111000000:E2
>000000000000:E3
>000000111111:E4
>111111000000:E5
>111111000000:E6
>111111000000:E7
>000000000000:E8
>111111000000:E9
>000000000000:E10
```

```
>XXXXXX000000:E11
>00000000000:E12
>111111000000:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>111111000000:E17
>111111000000:E18
>00000000000:E19
>111111000000:E20
>00000000000:E21
>00000000000:F0
>111111000000:F1
>00000000000:F2
>111111000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>00000000000:G7
>00000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>00000000000:J0
>00000000000:J1
```

116

```
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000111111:K0
>000000111111:K1
>000000111111:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000111111:DV
>111111000000:AMRD
>111111000000:CAR
>000000111111:OMRD
>111111000000:PAR
>000000111111:SUB
>000000111111:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 10
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>111111111111:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
```

```
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>11111111111:B1
>00000000000:B2
>11111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>11111111111:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>00000000000:D1
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
```

118

```
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000111111:F1
>000000000000:F2
>000000000000:F3
>000000111111:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
```

119

```
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>111111000000:K0
>111111000000:K1
>111111000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>111111000000:OMRD
>000000000000:PAR
>111111000000:SUB
>111111000000:ADD
```

```
>000000111111:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 11
sim> V NAV 00
sim> V MAC 11
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>111111111111:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
```

```
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
```

```
>00000000000:E21
>00000000000:F0
>111111000000:F1
>00000000000:F2
>00000000000:F3
>111111000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>00000000000:G7
>00000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>000000111111:I0
>000000111111:I1
>000000111111:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>000000111111:J0
>000000111111:J1
>000000111111:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
```

123

```
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>11111111111:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>11111100000:NDV
>00000000000:ROK
>11111100000:EMA
>00000000000:AMWR
>00000000000:EWR
>00000000000:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>00000000000:SUB
>00000000000:ADD
>11111100000:AMPA
>000000111111:PDMR
>000000111111:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l To State 12
sim> V MAC 00
sim> G 12
>00000000000:A0
>11111111111:A1
>00000000000:A2
>11111111111:A3
>00000000000:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>11111111111:B1
```

124

```
>00000000000:B2
>11111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>11111111111:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>00000000000:D1
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>00000000000:D11
>00000000000:D12
>00000000000:D13
>00000000000:D14
>00000000000:D15
>00000000000:D16
>00000000000:D17
>00000000000:D18
```

125

```
>00000000000:D19
>00000000000:D20
>00000000000:D21
>00000000000:D22
>00000000000:E0
>11111111111:E1
>00000000000:E2
>00000000000:E3
>11111111111:E4
>00000000000:E5
>00000000000:E6
>00000000000:E7
>00000000000:E8
>00000000000:E9
>00000000000:E10
>00000000000:E11
>00000000000:E12
>00000000000:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>00000000000:E17
>00000000000:E18
>00000000000:E19
>00000000000:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
```

```
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Set Write Adrs to 14
sim> h A2
```

```
sim> I To State 13
sim> V AV 11
sim> V NRF 11
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>111111111111:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
```

128

```
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000111111:F1
>000000111111:F2
>000000111111:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
```

```
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>00000000000:G7
>00000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>111111111111:AV
>111111111111:NRF
```

```
>000000000000:MAC
>000000000000:NAV
>000000111111:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000111111:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 14
sim> V AV 00
sim> V NRF 00
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>111111111111:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
```

```
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
```

132

```
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
```

```
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>111111111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 16
sim> V MAC 11
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>111111111111:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
```

134

```
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
```

```
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>00000000000:D11
>00000000000:D12
>00000000000:D13
>00000000000:D14
>00000000000:D15
>00000000000:D16
>00000000000:D17
>00000000000:D18
>00000000000:D19
>00000000000:D20
>00000000000:D21
>00000000000:D22
>00000000000:E0
>11111111111:E1
>00000000000:E2
>00000000000:E3
>11111111111:E4
>00000000000:E5
>00000000000:E6
>00000000000:E7
>00000000000:E8
>00000000000:E9
>00000000000:E10
>00000000000:E11
>00000000000:E12
>00000000000:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>00000000000:E17
>00000000000:E18
>00000000000:E19
>00000000000:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
```

```
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>111111000000:EWR
>000000111111:DV
```

```
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 17
sim> V MAC 00
sim> V NAV 11
sim> G 12
>00000000000:A0
>111111111111:A1
>111111111111:A2
>111111111111:A3
>00000000000:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>111111111111:B1
>00000000000:B2
>111111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
```

138

```
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
```

```
>00000000000:E15
>00000000000:E16
>00000000000:E17
>00000000000:E18
>00000000000:E19
>00000000000:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:14
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>11111111111:J0
>11111111111:J1
>11111111111:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
```

```
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 12
sim> V NAV 00
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>111111111111:A3
>000000000000:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
```

141

```
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>11111111111:B1
>00000000000:B2
>11111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>11111111111:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>00000000000:D1
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>00000000000:D11
>00000000000:D12
```

142

```
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
```

```
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
```

>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Set Write Adrs to 18 (Matches Predicted Adrs)
sim> 1 A2 A3
sim> h A4
sim> l To State 13
sim> V AV 11
sim> V NRF 11
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>111111111111:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6

```
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
```

```
>000000111111:F1
>000000000000:F2
>000000000000:F3
>000000111111:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
```

```
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>111111111111:AV
>111111111111:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000111111:MT
>000000000000:RESET
>000000000000:NDV
>111111000000:ROK
>000000111111:EMA
>000000111111:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000111111:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 15
sim> V AV 00
sim> V NRF 00
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>111111111111:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
```

148

```
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111111111:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
```

149

```
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
```

```
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>111111111111:I4
>111111111111:I5
>111111111111:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>111111111111:J4
>111111111111:J5
>111111111111:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>111111111111:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>111111111111:PDR
>111111111111:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 16
sim> V MAC 11
sim> G 12
```

151

```
>00000000000:A0
>11111111111:A1
>00000000000:A2
>00000000000:A3
>11111111111:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>11111111111:B1
>00000000000:B2
>11111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>11111111111:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
```

152

```
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
```

```
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>11111100000:I4
>11111100000:I5
>11111100000:I6
>00000000000:I7
>00000000000:I8
>00000000000:J0
>00000000000:J1
>00000000000:J2
>00000000000:J3
>11111111111:J4
>11111111111:J5
>11111111111:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>11111111111:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
```

154

```
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>111111000000:EWR
>000000111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>111111000000:PDR
>111111000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | To State 17
sim> V MAC 00
sim> V NAV 11
sim> G 12
>000000000000:A0
>111111111111:A1
>000000000000:A2
>000000000000:A3
>111111111111:A4
>000000000000:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>000000000000:B2
>111111111111:B3
>000000000000:B4
>000000000000:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
```

155

```
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>11111111111:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>00000000000:D1
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>00000000000:D11
>00000000000:D12
>00000000000:D13
>00000000000:D14
>00000000000:D15
>00000000000:D16
>00000000000:D17
>00000000000:D18
>00000000000:D19
>00000000000:D20
>00000000000:D21
>00000000000:D22
>00000000000:E0
>11111111111:E1
>00000000000:E2
>00000000000:E3
>11111111111:E4
>00000000000:E5
>00000000000:E6
>00000000000:E7
```

```
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
```

```
>00000000000:I8
>00000000000:J0
>00000000000:J1
>00000000000:J2
>00000000000:J3
>11111111111:J4
>11111111111:J5
>11111111111:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>00000000000:MAC
>11111111111:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>000000111111:NDV
>00000000000:ROK
>00000000000:EMA
>00000000000:AMWR
>00000000000:EWR
>111111000000:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 12
sim> V NAV 00
sim> G 12
>00000000000:A0
>11111111111:A1
>00000000000:A2
>00000000000:A3
>11111111111:A4
>00000000000:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
```

```
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>11111111111:B1
>00000000000:B2
>11111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>11111111111:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>00000000000:D1
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
```

```
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
```

```
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>111111111111:J4
>111111111111:J5
>111111111111:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>111111111111:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
```

```
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Set Read Adrs to 32
sim> l A1 A4
sim> h A5
sim> l To State 18
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> G 12
>00000000000:A0
>00000000000:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>111111111111:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>111111111111:B1
>00000000000:B2
>111111111111:B3
>00000000000:B4
>00000000000:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
```

162

```
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>111111000000:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000000000:D1
>000000000000:D2
>111111111111:D3
>000000000000:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
```

163

```
>00000000000:E15
>00000000000:E16
>00000000000:E17
>00000000000:E18
>00000000000:E19
>00000000000:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>000000111111:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>00000000000:G7
>00000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>00000000000:J0
>00000000000:J1
>00000000000:J2
>00000000000:J3
>111111111111:J4
>111111111111:J5
```

```
>11111111111:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>11111111111:RDWR
>11111111111:AV
>11111111111:NRF
>00000000000:MAC
>00000000000:NAV
>000000111111:NMT
>00000000000:MT
>00000000000:RESET
>00000000000:NDV
>111111000000:ROK
>00000000000:EMA
>00000000000:AMWR
>00000000000:EWR
>00000000000:DV
>000000111111:AMRD
>000000111111:CAR
>00000000000:OMRD
>000000111111:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>000000111111:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | To State 19
sim> V RDWR 00
sim> V AV 00
sim> V NRF 00
sim> G 12
>00000000000:A0
>00000000000:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>11111111111:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
```

165

```
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>00000000000:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
>11111111111:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>00000000000:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>00000000000:D1
>00000000000:D2
>11111111111:D3
>00000000000:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
```

166

```
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000000000:E2
>000000000000:E3
>111111111111:E4
>000000000000:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
```

```
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>111111111111:J4
>111111111111:J5
>111111111111:J6
>000000000000:J7
>000000000000:J8
>111111111111:K0
>111111111111:K1
>111111111111:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>111111111111:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>111111111111:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
```

168

```
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 21
sim> V MAC 11
sim> G 12
>000000000000:A0
>000000000000:A1
>000000000000:A2
>000000000000:A3
>000000000000:A4
>111111111111:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>000000000000:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>111111111111:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111111111:C1
>111111111111:C2
>000000000000:C3
>111111111111:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
```

169

```
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>000000111111:D1
>000000111111:D2
>111111000000:D3
>000000111111:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>000000111111:E2
>000000000000:E3
>111111111111:E4
>000000111111:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
```

```
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>111111111111:J4
>111111111111:J5
>111111111111:J6
>000000000000:J7
>000000000000:J8
>111111000000:K0
>111111000000:K1
>111111000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
```

171

```
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>111111111111:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
>00000000000:RESET
>00000000000:NDV
>00000000000:ROK
>111111000000:EMA
>00000000000:AMWR
>00000000000:EWR
>000000111111:DV
>00000000000:AMRD
>00000000000:CAR
>111111000000:OMRD
>00000000000:PAR
>000000111111:SUB
>000000111111:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>00000000000:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 10
sim> V MAC 00
sim> V NAV 11
sim> G 12
>00000000000:A0
>00000000000:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>111111111111:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>00000000000:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
```

172

```
>11111111111:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>00000000000:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>11111111111:D1
>11111111111:D2
>00000000000:D3
>11111111111:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>00000000000:D11
>00000000000:D12
>00000000000:D13
>00000000000:D14
>00000000000:D15
>00000000000:D16
>00000000000:D17
>00000000000:D18
>00000000000:D19
>00000000000:D20
>00000000000:D21
```

```
>00000000000:D22
>00000000000:E0
>11111111111:E1
>11111111111:E2
>00000000000:E3
>11111111111:E4
>11111111111:E5
>00000000000:E6
>00000000000:E7
>00000000000:E8
>00000000000:E9
>00000000000:E10
>00000000000:E11
>00000000000:E12
>00000000000:E13
>00000000000:E14
>00000000000:E15
>00000000000:E16
>00000000000:E17
>00000000000:E18
>00000000000:E19
>00000000000:E20
>00000000000:E21
>00000000000:F0
>000000111111:F1
>000000111111:F2
>00000000000:F3
>000000111111:F4
>000000111111:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
```

174

```
>000000000000:H8
>000000000000:10
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000000000:J0
>000000000000:J1
>000000000000:J2
>000000000000:J3
>111111111111:J4
>111111111111:J5
>111111111111:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>111111111111:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000111111:NDV
>000000000000:ROK
>000000111111:EMA
>000000000000:AMWR
>000000000000:EWR
>111111000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>111111000000:SUB
>111111000000:ADD
>000000111111:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 11
sim> V NAV 00
sim> V MAC 11
sim> G 12
>000000000000:A0
```

```
>00000000000:A1
>00000000000:A2
>00000000000:A3
>00000000000:A4
>11111111111:A5
>00000000000:A6
>00000000000:A7
>00000000000:A8
>00000000000:A9
>00000000000:A10
>00000000000:A11
>00000000000:A12
>00000000000:A13
>00000000000:A14
>00000000000:A15
>00000000000:A16
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>00000000000:B1
>00000000000:B2
>00000000000:B3
>00000000000:B4
>11111111111:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>11111111111:C1
>11111111111:C2
>00000000000:C3
>11111111111:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
```

```
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>111111111111:D1
>111111111111:D2
>000000000000:D3
>111111111111:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>111111111111:E2
>000000000000:E3
>111111111111:E4
>111111111111:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>111111000000:F1
>111111000000:F2
>000000000000:F3
>111111000000:F4
>111111000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
```

177

```
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000111111:I0
>000000111111:I1
>000000111111:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>000000111111:J0
>000000111111:J1
>000000111111:J2
>000000000000:J3
>111111000000:J4
>111111000000:J5
>111111000000:J6
>000000000000:J7
>000000000000:J8
>000000000000:K0
>000000000000:K1
>000000000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
```

```
>111111000000:NDV
>000000000000:ROK
>111111000000:EMA
>000000000000:AMWR
>000000000000:EWR
>000000000000:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>111111000000:AMPA
>000000111111:PDMR
>000000111111:PDR
>000000000000:DMCP
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> l Set Read Adrs to 54 (Matches Predicted Adrs)
sim> h A4 A2 A1
sim> l To State 18
sim> V RDWR 11
sim> V AV 11
sim> V NRF 11
sim> V MAC 00
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>000000000000:A3
>111111111111:A4
>111111111111:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>000000000000:B1
>000000000000:B2
>000000000000:B3
>000000000000:B4
>111111111111:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
```

179

```
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>111111000000:C1
>111111000000:C2
>000000000000:C3
>111111000000:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>111111111111:D1
>111111111111:D2
>000000000000:D3
>111111111111:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>111111111111:E2
>000000000000:E3
>111111111111:E4
```

```
>111111111111:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000111111:F1
>000000111111:F2
>000000000000:F3
>000000111111:F4
>000000111111:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
```

```
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>11111111111:J0
>11111111111:J1
>11111111111:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>11111111111:RDWR
>11111111111:AV
>11111111111:NRF
>00000000000:MAC
>00000000000:NAV
>00000000000:NMT
>000000111111:MT
>00000000000:RESET
>00000000000:NDV
>111111000000:ROK
>00000000000:EMA
>00000000000:AMWR
>00000000000:EWR
>00000000000:DV
>000000111111:AMRD
>000000111111:CAR
>00000000000:OMRD
>000000111111:PAR
>00000000000:SUB
>00000000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
>000000111111:COM
>00000000000:OMPR
>00000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 20
sim> V RDWR 00
sim> V AV 00
sim> V NRF 00
sim> G 12
>00000000000:A0
>11111111111:A1
>11111111111:A2
>00000000000:A3
>11111111111:A4
>11111111111:A5
```

182

```
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>111111111111:B2
>000000000000:B3
>111111111111:B4
>111111111111:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
>000000000000:B21
>000000000000:C0
>000000000000:C1
>000000000000:C2
>000000000000:C3
>000000000000:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
```

183

```
>111111111111:D1
>111111111111:D2
>000000000000:D3
>111111111111:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111111111:E1
>111111111111:E2
>000000000000:E3
>111111111111:E4
>111111111111:E5
>000000000000:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
```

```
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
>000000000000:G7
>000000000000:G8
>111111111111:H0
>111111111111:H1
>111111111111:H2
>000000000000:H3
>000000000000:H4
>000000000000:H5
>000000000000:H6
>000000000000:H7
>000000000000:H8
>000000000000:I0
>000000000000:I1
>000000000000:I2
>000000000000:I3
>000000000000:I4
>000000000000:I5
>000000000000:I6
>000000000000:I7
>000000000000:I8
>111111111111:J0
>111111111111:J1
>111111111111:J2
>000000000000:J3
>000000000000:J4
>000000000000:J5
>000000000000:J6
>000000000000:J7
>000000000000:J8
>111111111111:K0
>111111111111:K1
>111111111111:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>000000000000:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
```

185

```
>111111111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000000000:SUB
>000000000000:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>111111111111:OMPR
>111111111111:MACE
>110000110000:clka
>000110000110:clkb
sim> I To State 21
sim> V MAC 11
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>000000000000:A3
>111111111111:A4
>111111111111:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
>000000000000:A17
>000000000000:A18
>000000000000:A19
>000000000000:A20
>000000000000:A21
>000000000000:B0
>111111111111:B1
>111111111111:B2
>000000000000:B3
>111111111111:B4
>111111111111:B5
>000000000000:B6
>000000000000:B7
>000000000000:B8
>000000000000:B9
>000000000000:B10
>000000000000:B11
>000000000000:B12
>000000000000:B13
>000000000000:B14
>000000000000:B15
>000000000000:B16
>000000000000:B17
>000000000000:B18
>000000000000:B19
>000000000000:B20
```

186

```
>000000000000:B21
>000000000000:C0
>000000000000:C1
>000000000000:C2
>000000000000:C3
>000000000000:C4
>111111111111:C5
>111111111111:C6
>111111111111:C7
>111111111111:C8
>111111111111:C9
>111111111111:C10
>111111111111:C11
>111111111111:C12
>111111111111:C13
>111111111111:C14
>111111111111:C15
>111111111111:C16
>111111111111:C17
>111111111111:C18
>111111111111:C19
>111111111111:C20
>111111111111:C21
>111111111111:C22
>000000000000:D0
>111111111111:D1
>111111111111:D2
>000000000000:D3
>111111111111:D4
>000000000000:D5
>000000000000:D6
>000000000000:D7
>000000000000:D8
>000000000000:D9
>000000000000:D10
>000000000000:D11
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>111111000000:E1
>111111111111:E2
>000000111111:E3
>111111000000:E4
>111111000000:E5
>000000111111:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
```

```
>00000000000:E15
>00000000000:E16
>00000000000:E17
>00000000000:E18
>00000000000:E19
>00000000000:E20
>00000000000:E21
>00000000000:F0
>00000000000:F1
>00000000000:F2
>00000000000:F3
>00000000000:F4
>00000000000:F5
>00000000000:F6
>00000000000:F7
>00000000000:F8
>00000000000:F9
>00000000000:F10
>00000000000:F11
>00000000000:F12
>00000000000:F13
>00000000000:F14
>00000000000:F15
>00000000000:F16
>00000000000:F17
>00000000000:F18
>00000000000:F19
>00000000000:F20
>00000000000:F21
>00000000000:G0
>00000000000:G1
>00000000000:G2
>00000000000:G3
>11111111111:G4
>11111111111:G5
>11111111111:G6
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>11111111111:J0
>11111111111:J1
>11111111111:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
```

```
>000000000000:J6
>000000000000:J7
>000000000000:J8
>111111000000:K0
>111111000000:K1
>111111000000:K2
>000000000000:K3
>000000000000:K4
>000000000000:K5
>000000000000:K6
>000000000000:K7
>000000000000:K8
>000000000000:RDWR
>000000000000:AV
>000000000000:NRF
>111111111111:MAC
>000000000000:NAV
>000000000000:NMT
>000000000000:MT
>000000000000:RESET
>000000000000:NDV
>000000000000:ROK
>000000000000:EMA
>000000000000:AMWR
>000000000000:EWR
>111111111111:DV
>000000000000:AMRD
>000000000000:CAR
>000000000000:OMRD
>000000000000:PAR
>000000111111:SUB
>000000111111:ADD
>000000000000:AMPA
>000000000000:PDMR
>000000000000:PDR
>000000000000:DMCP
>000000000000:COM
>111111000000:OMPR
>111111000000:MACE
>110000110000:clka
>000110000110:clkb
sim> | Check RESET operation To State 0
sim> V MAC 00
sim> V RESET 11
sim> G 12
>000000000000:A0
>111111111111:A1
>111111111111:A2
>000000000000:A3
>111111111111:A4
>111111111111:A5
>000000000000:A6
>000000000000:A7
>000000000000:A8
>000000000000:A9
>000000000000:A10
>000000000000:A11
>000000000000:A12
>000000000000:A13
>000000000000:A14
>000000000000:A15
>000000000000:A16
```

189

```
>00000000000:A17
>00000000000:A18
>00000000000:A19
>00000000000:A20
>00000000000:A21
>00000000000:B0
>11111111111:B1
>11111111111:B2
>00000000000:B3
>11111111111:B4
>11111111111:B5
>00000000000:B6
>00000000000:B7
>00000000000:B8
>00000000000:B9
>00000000000:B10
>00000000000:B11
>00000000000:B12
>00000000000:B13
>00000000000:B14
>00000000000:B15
>00000000000:B16
>00000000000:B17
>00000000000:B18
>00000000000:B19
>00000000000:B20
>00000000000:B21
>00000000000:C0
>00000000000:C1
>00000000000:C2
>00000000000:C3
>00000000000:C4
>11111111111:C5
>11111111111:C6
>11111111111:C7
>11111111111:C8
>11111111111:C9
>11111111111:C10
>11111111111:C11
>11111111111:C12
>11111111111:C13
>11111111111:C14
>11111111111:C15
>11111111111:C16
>11111111111:C17
>11111111111:C18
>11111111111:C19
>11111111111:C20
>11111111111:C21
>11111111111:C22
>00000000000:D0
>11111111111:D1
>11111111111:D2
>00000000000:D3
>11111111111:D4
>00000000000:D5
>00000000000:D6
>00000000000:D7
>00000000000:D8
>00000000000:D9
>00000000000:D10
>00000000000:D11
```

190

```
>000000000000:D12
>000000000000:D13
>000000000000:D14
>000000000000:D15
>000000000000:D16
>000000000000:D17
>000000000000:D18
>000000000000:D19
>000000000000:D20
>000000000000:D21
>000000000000:D22
>000000000000:E0
>000000000000:E1
>111111111111:E2
>111111111111:E3
>000000000000:E4
>000000000000:E5
>111111111111:E6
>000000000000:E7
>000000000000:E8
>000000000000:E9
>000000000000:E10
>000000000000:E11
>000000000000:E12
>000000000000:E13
>000000000000:E14
>000000000000:E15
>000000000000:E16
>000000000000:E17
>000000000000:E18
>000000000000:E19
>000000000000:E20
>000000000000:E21
>000000000000:F0
>000000000000:F1
>000000000000:F2
>000000000000:F3
>000000000000:F4
>000000000000:F5
>000000000000:F6
>000000000000:F7
>000000000000:F8
>000000000000:F9
>000000000000:F10
>000000000000:F11
>000000000000:F12
>000000000000:F13
>000000000000:F14
>000000000000:F15
>000000000000:F16
>000000000000:F17
>000000000000:F18
>000000000000:F19
>000000000000:F20
>000000000000:F21
>000000000000:G0
>000000000000:G1
>000000000000:G2
>000000000000:G3
>111111111111:G4
>111111111111:G5
>111111111111:G6
```

191

```
>00000000000:G7
>00000000000:G8
>11111111111:H0
>11111111111:H1
>11111111111:H2
>00000000000:H3
>00000000000:H4
>00000000000:H5
>00000000000:H6
>00000000000:H7
>00000000000:H8
>00000000000:I0
>00000000000:I1
>00000000000:I2
>00000000000:I3
>00000000000:I4
>00000000000:I5
>00000000000:I6
>00000000000:I7
>00000000000:I8
>11111111111:J0
>11111111111:J1
>11111111111:J2
>00000000000:J3
>00000000000:J4
>00000000000:J5
>00000000000:J6
>00000000000:J7
>00000000000:J8
>00000000000:K0
>00000000000:K1
>00000000000:K2
>00000000000:K3
>00000000000:K4
>00000000000:K5
>00000000000:K6
>00000000000:K7
>00000000000:K8
>00000000000:RDWR
>00000000000:AV
>00000000000:NRF
>00000000000:MAC
>00000000000:NAV
>00000000000:NMT
>00000000000:MT
>11111111111:RESET
>000000111111:NDV
>000000111111:ROK
>00000000000:EMA
>00000000000:AMWR
>00000000000:EWR
>111111000000:DV
>00000000000:AMRD
>00000000000:CAR
>00000000000:OMRD
>00000000000:PAR
>111111000000:SUB
>111111000000:ADD
>00000000000:AMPA
>00000000000:PDMR
>00000000000:PDR
>00000000000:DMCP
```

```
>000000000000:COM
>000000000000:OMPR
>000000000000:MACE
>110000110000:clka
>000110000110:clkb
sim> quit
```

LIST OF REFERENCES

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